New Junior Encyclopedia

Vol 13

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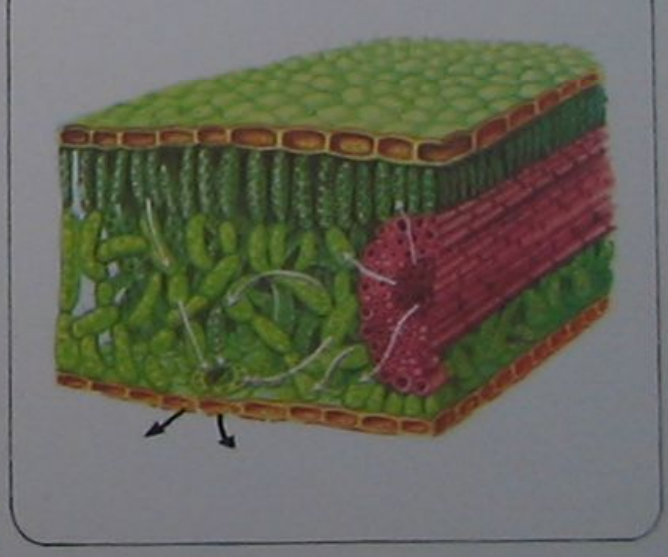


Tambourines and drums are *percussion* instruments—they are struck to produce a note.

Parasites are plants or animals that live in or on other plants or animals and take food from these so-called *hosts*. Examples of animal parasites are fleas, lice, tapeworms and liver-flukes. Plant parasites include dodder, mistletoe, mildew fungi and many bacteria.

Parasitic organisms are unable to live a free life for long. They live in close contact with their host and are completely dependent on it for food. They give nothing in return. The host may, in fact, be severely harmed. Many parasites are the cause of diseases.

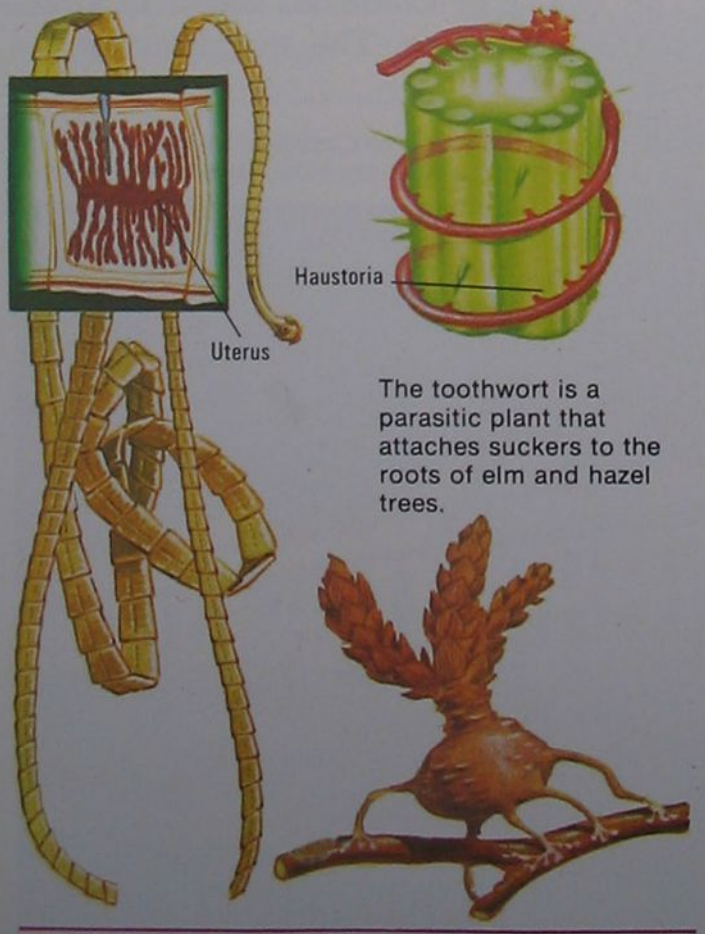
Many parasitic animals have lost the ability to move, and their sense organs may be very poor. Plant parasites, except such partial parasites as mistletoe, have no chlorophyll and so cannot make their own food by *photosynthesis* (see Photosynthesis).

Most *ectoparasites* (parasites that live outside their host) have some kind of suckers with which to penetrate the host and obtain food. Dodder, for example, sends suckers called *haustoria* into the stem of its host and 'taps' the host's internal circulation. Such animal parasites as fleas suck the blood of their host.

Endoparasites live inside the body of their host. Tapeworms, for example, attach themselves by hooks to the inside of their host's intestine. There, they can obtain a ready supply of digested food. Parasitic viruses live within the host's actual cells.

A parasite's main activity is to produce vast numbers of eggs or seeds to make sure that the species continues. Some animal parasites—the tapeworm, for example—have a *two-host life history*. They spend part of their life cycle in one host (such as man) and part in another (such as a pig).

Left: A tapeworm consists of many segments. A ripe segment (inset) contains a branched uterus full of eggs. Right: The dodder sends suckers called haustoria into a nettle stem to tap its host's tissues.



The toothwort is a parasitic plant that attaches suckers to the roots of elm and hazel trees.

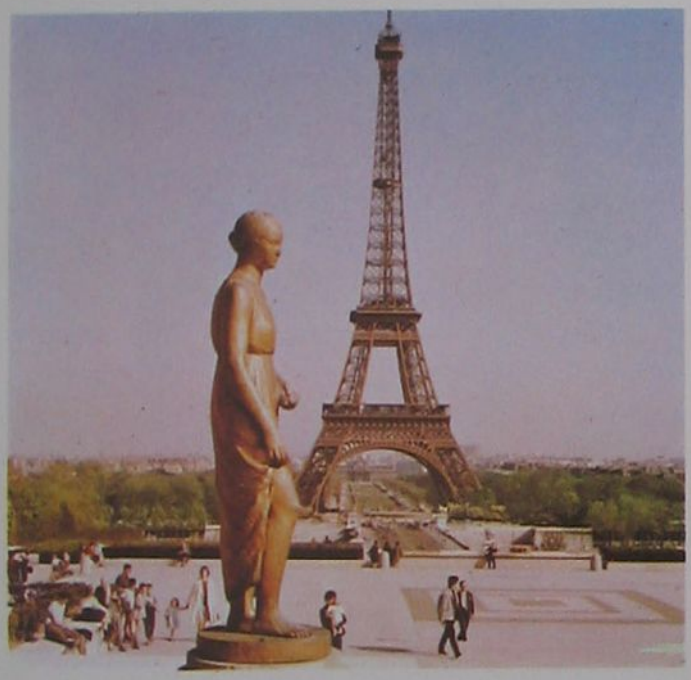
Paris is the capital of France. The city lies on the River Seine, 110 miles from the sea at Le Havre. The river makes a natural division of the city into Right and Left banks. Ile de la Cité is an island on the Seine and was the original Gallic settlement of *Parisii* from which modern Paris has developed.

The population of the metropolitan area is 8,200,000, and ranks Paris among the largest cities of the world. It is also the most densely populated city in Europe.

The city is the presidential seat. The Elysée Palace is the official home of the President of the Republic. The city is also the seat of the government. The Assemblée Nationale (Chamber of Deputies) is the head chamber of the French parliament. The Palais du Luxembourg, a former royal palace, is used for sittings of the senate.

The city is a great railway centre of France, and the chief commercial and manufacturing centre. It has major industries in clothing, machinery, jewellery, and food processing.

Paris is also one of the leading fashion



The Nôtre Dame Cathedral lies on a small island in the River Seine in the heart of Paris. The 984-foot Eiffel Tower is the tallest building in Paris.

centres of the world, and an important centre of culture, art, and literature. The Musée du Louvre, a former royal palace, contains six collections of art treasures forming one of the most magnificent and complete displays in the world.

The University of Paris (Sorbonne) was founded in 1253 for sixteen poor students of theology. It has grown to world-famed status, attracting students from many parts. The Bibliothèque Nationale is the oldest of Europe's national libraries and contains more than six million books.

The city is the seat of a Roman Catholic archbishop. The Cathedral of Nôtre Dame on the Île de la Cité is one of the most beautiful Gothic structures in Europe.

Paris has long been considered the most beautiful city in the world. Its open squares and wide tree-lined boulevards running along the lines of the former medieval fortifications are of great charm.

Parliament means 'talking'. Elected representatives of the people meet to talk over and pass laws. The British parliament has a House of Commons with 635 elected members and a non-elected House of Lords (with about 100 regular attenders). The American Congress has a House of Representatives with 435 elected Representatives, and a Senate which is made up of two elected senators from each State, whatever its size. (See Elections.)

The oldest parliament is the Icelandic 'Althing', but the 'Mother of Parliaments' is Britain's, which is at least seven hundred years old. Parliaments in many countries have been copied from Britain's, or have begun by trying to improve on it. The House of Commons meets in a rectangular building. The supporters of the

Australia's parliament is in Canberra, the capital. Canberra lies in the Australian Capital Territory.

Government sit on one side and the Opposition on the other. The proceedings are presided over by the Speaker who is impartial. He maintains order in the House and members have to have his permission before they can speak in a debate.

Some parliaments meet in a semicircular building: conservatives sit on the right and radicals and socialists on the left. So 'right' in politics has come to mean conservatives, and 'left' to mean radical (wanting reform).

Parliaments are places in which laws *(legislation)* are passed; parliament is the *legislature*. The government (President, or Prime Minister, and Cabinet) is called the *executive*. The judges, the *judicature*, decide what the laws mean and whether the executive has broken the law. In America these three are separated. The President and his Cabinet are not members of parliament and the Supreme Court (the senior judges) can decide that a law is against the constitution. British judges cannot overrule laws passed by parliament. The Prime Minister and his Cabinet are members of parliament and parliament can get rid of the executive. (See Constitution; Government; Political Parties.)

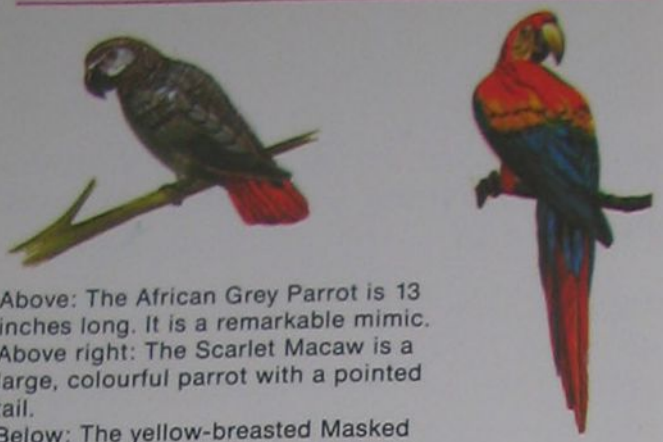
The tiny hanging parrots of South-East Asia sleep hanging upside down, like bats.

Parrots The 300 members of the parrot group are found in most of the warmer parts of the world, but they are especially numerous in Australia. The birds range in size from the 3½-inch-long pigmy parrots to the 40-inch-long macaws. Other members of the family include the true parrots, parakeets, cockatoos, lorikeets, lovebirds and budgerigars.

Parrots usually live in flocks in forests. They have loud, harsh voices, and they are continually squawking. They eat fruit, seeds and nuts, and they often fly long distances to look for their food. They nest in holes in trees and lay white eggs.

The shapes and colours of the parrot family vary enormously. Most of the birds have large heads set on short necks, with

The Major Mitchell or Pink cockatoo. These birds, which come from Indonesia, Australia and neighbouring islands, are easily tamed, but they seldom learn to talk. Instead, they have the disadvantage of giving frequent loud screams.



Above: The African Grey Parrot is 13 inches long. It is a remarkable mimic.
Above right: The Scarlet Macaw is a large, colourful parrot with a pointed tail.
Below: The yellow-breasted Masked Lovebird is only five inches long. The Black Cockatoo is 13 inches long.

strong, down-curved, hooked beaks. These beaks are capable of causing nasty wounds, and a big macaw can easily bite a finger off. The parrot's powerful feet have two toes in front and two toes behind.

There are five main classes of parrots. The true parrots are square-tailed birds that often show a lot of green in their plumage. Macaws are large birds with pointed tails. Parakeets, which include the budgerigars, are small birds with long, pointed tails. Cockatoos are mostly white, with a crest of feathers on the head. Lories, which include lorikeets, are beautiful little parrots with orange bills.

Parrots do not actually talk, but they are famous for their ability to copy or mimic sounds. They develop this ability only in captivity but they cannot understand words. The African Grey Parrot is probably the best mimic of all. Caged parrots, if well looked after, may live for 50 years or more.

Parthenon This is a temple to the Greek goddess Athena. It was built between 447 and 432 B.C. on the Acropolis, or citadel (fortress), of Athens, the remains of which still dominate the Greek capital today.

Athena was the patron-goddess of the great Greek City, and the temple was erected to contain a huge statue of her made by the sculptor Phidias. Around the outside walls of the great temple chamber was a frieze of figures in relief, and the gables of the building were filled with superb statues. These are now in the British Museum, and are known as the Elgin Marbles, after Lord Elgin who took them to England. In the A.D. 500's, the Parthenon became a Christian church. The Turks captured Athens in the 1400's and converted the temple into a mosque. They later used it as an ammunition store, and when the Venetians attacked Athens in 1687, the powder blew up and destroyed the roof of the building. The Parthenon is one of the major tourist attractions of Greece.

Passport This is a document issued by governments to citizens who wish to travel to other countries. The passport identifies the citizen and requests that he be given

The ruins of the Parthenon (below) still stand above Athens but the great statue of Athena has been lost.

a safe passage wherever he goes. When a traveller arrives in a foreign country or leaves it, his passport is stamped with the date and the place of arrival or departure. A government occasionally withholds a passport to prevent a citizen leaving the country. Certain countries do not demand passports from travellers from nearby countries. Others demand that the passport be stamped with a *visa* by their embassy or consulate. The visa permits the traveller to remain in the country for a limited period of time.

Pasteur, Louis (1822-1895), was an outstanding French scientist. He is credited with being the founder of the science of *bacteriology*. Millions of people have had their lives saved because of his discoveries.

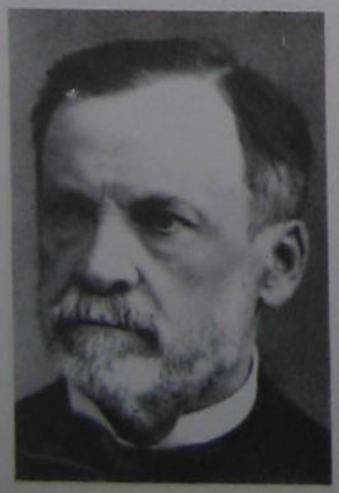
Pasteur realized that diseases were caused by tiny living *organisms* that are found everywhere. These organisms called *bacteria*, or germs, are actually the carriers of disease. Pasteur discovered that germs could be killed by using heat, or by chemical means, and so stopped from spreading. The English surgeon Joseph Lister took up Pasteur's work, and developed *antiseptics*, which reduced the risk of further infection after operations.

Pasteur also discovered that bacteria cause food to decay. He developed a method of preserving food, called *pasteurization* in his honour. This is most commonly applied to milk, which is heated to a high temperature for 15 seconds and then cooled. The heating kills most of the bacteria, while the cooling prevents those left from multiplying quickly again.

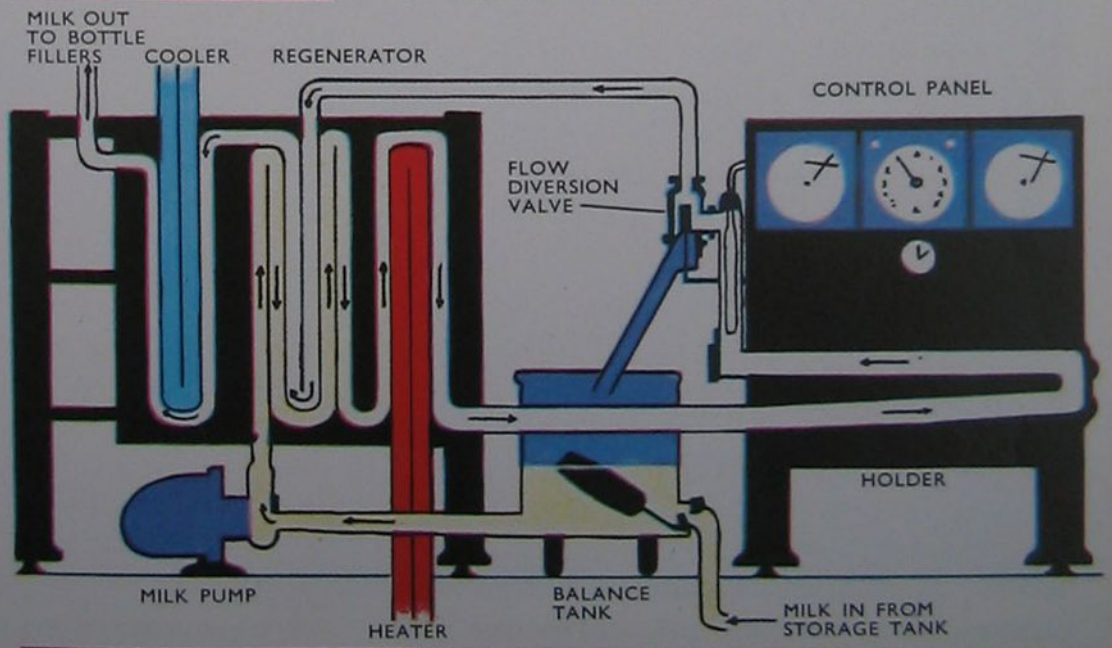
In experiments on vaccination, Pasteur developed methods for preventing infections in animals, such as anthrax and cholera. He injected the weakened germs of the disease into the animals, and they became *immune* – that is, resistant to the disease. The first vaccination Pasteur performed on a human being was on a boy who had been bitten by a mad dog. This usually causes *hydrophobia* (rabies), but Pasteur was successful and the boy lived.

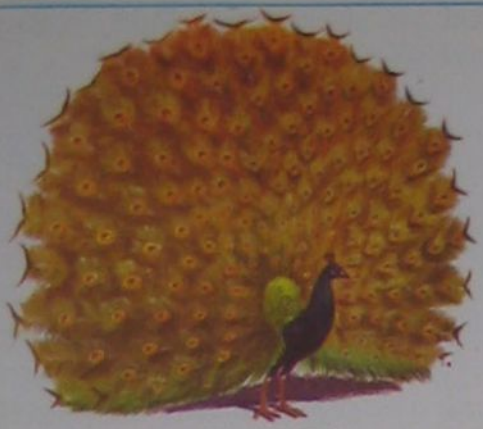
Paul, Saint, was the greatest missionary, or messenger, of the early Christian Church. A devout Jew and Roman citizen born in Tarsus, his original name was Saul. During his young manhood he was an eager and savage persecutor of Christians,

Louis Pasteur was a French scientist who discovered that germs could be killed by heat or certain chemicals.



Pasteurization is a process of killing harmful germs in milk by heating it. In a pasteurization plant, the cold incoming milk is warmed by heat from the hot outgoing milk in the regenerator. It is then heated by hot water in the heater, and held at a temperature of 161°F (72°C) for 15 seconds in the holder. It then passes through the regenerator, where it loses some heat to the incoming milk, and is cooled in the cooler to about 40°F (5°C). If the temperature of the milk is below 161°F (72°C) at the end of the holding period, it is automatically returned to the heater via the flow diversion valve.





A peacock displays its magnificent train.

whom he regarded as dangerous enemies of his established faith. But one day, on the road to Damascus, he claimed to have seen a vision of Christ, who appointed him to be the 'apostle to the Gentiles'.

Adopting the new name of Paul, he travelled widely, preaching and establishing churches in Asia Minor, Macedonia and Greece. The story of Paul is told in the Bible in the New Testament Book of *The Acts of the Apostles*, and in his 13 *epistles* (letters). He was executed about A.D. 62, probably in Rome.

Peacock This is a wild game bird that belongs to the same family as the common pheasant. The peacock is the male of the species called *peafowl*. The female is a *peahen*. The peacock is known throughout the world for its magnificent *train*. The train feathers grow from the back and are not actually part of the tail.

The peacock is about the size of a turkey, but when he shows off in front of the peahen he spreads out his train into a gorgeous fan that is several feet long. The feathers in his train are greenish and brilliantly marked with large, bold spots that look rather like eyes. The peahen is smaller, and has no train.

Peanuts is the popular name given to the seeds of certain *leguminous plants* (plants that produce pods, such as peas and beans). The peanut is also called *goober, ground pea, monkey-nut, earth-nut* and *ground-nut*. Originally a native of Brazil, it is now grown in many tropical and sub-tropical countries.

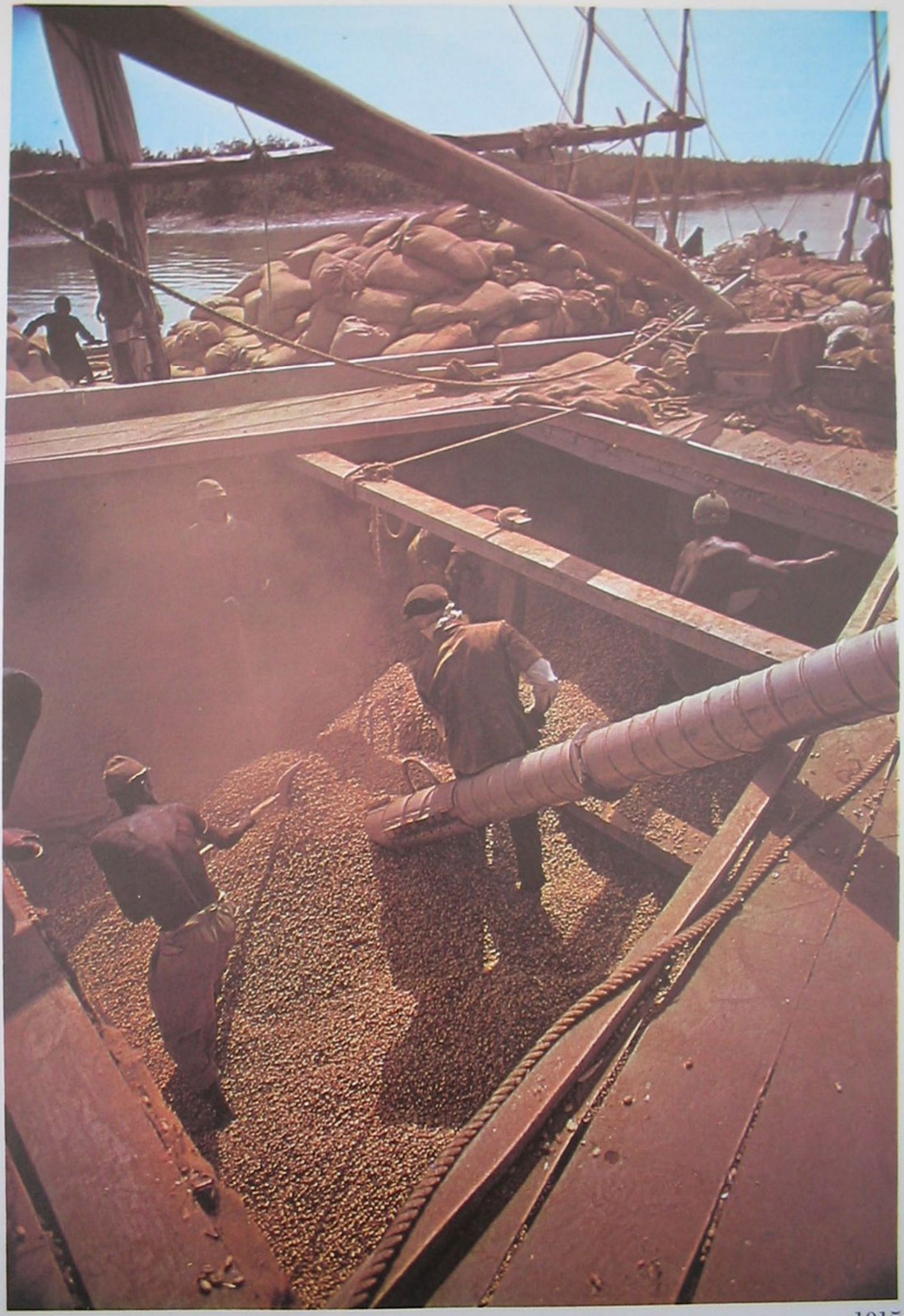
The pod is borne on a stalk after the flower has died off, and when it starts to form it buries itself in the earth to ripen. The seeds may be eaten raw, or roasted and salted. Peanut 'butter' is a popular product and the nuts are also a valuable source of vegetable oil.

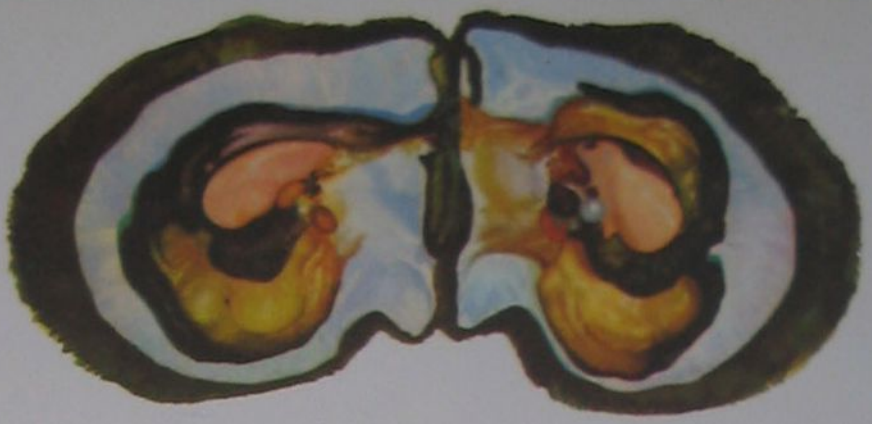
Pearl Harbor, on the island of Oahu in Hawaii, is a famous United States naval base. In 1941, a sudden attack on Pearl Harbor by a Japanese force led the United States to enter World War II. The attack began on the morning of 7 December. The Japanese used more than 350 carrier-borne planes. They took the American defences by surprise. The Japanese planes bombed the ships of the United States Pacific fleet that were anchored in the harbour. They also bombed a near-by airfield. Eighteen American warships were sunk or badly damaged, including eight battleships. About 170 American planes were destroyed, and more than 2,300 people killed.

Pearl Harbor is one of the world's largest and finest natural harbours. It is surrounded by land, except in the south where a wide channel provides an outlet to the Pacific Ocean. The United States first established a naval base there in 1900. The base was improved and strengthened in the 1930's and 1940's.

Pearls are valuable jewels formed in pearl oysters of tropical seas. All oysters produce a special lining inside their shells made of a substance called *nacre*, or *mother of pearl*. If a grain of sand or some other foreign body enters the oyster, layers of nacre are built up round the grain and a pearl is slowly formed. But only the pearls of pearl oysters have the lustre that makes them valuable. *Natural*

Opposite: Loading peanuts on to a ship in Gambia. They are an important crop in many African countries.





Pearls are sometimes found in oysters that live in tropical seas. They form around grains of sand or other foreign bodies. The blue substance is nacre, or mother of pearl, the same substance that forms the pearls themselves.

pearls are pearls found in the sea, often by pearl divers. *Cultured* pearls are real pearls grown in special pearl oyster beds built by the sea shore. *Artificial* pearls are made of glass and coated with a *pearl essence* made from fish scales.

Pearson, Lester Bowles (1897-1973) was Prime Minister of Canada from 1963 to 1968. A former teacher and diplomat, in 1948 he was elected to Parliament and appointed secretary of state for external affairs. In October 1957 he was awarded the Nobel peace prize for his part in resolving the Suez crisis. In 1958 he was elected leader of the Liberal party, then out of office, and became Prime Minister in 1963.

Peary, Robert (1856-1920), an American explorer, was the first man to reach the North Pole. Peary had made two unsuccessful attempts to reach the Pole before succeeding on 6 April 1909. He published an account of his expedition in a book called *The North Pole*.

Peary began his Arctic explorations in 1886 with a journey to Greenland. He proved that Greenland is an island, and he made important scientific observations. His first attempt to reach the Pole began in 1898 and lasted four years. His second attempt, in 1905-1906, nearly succeeded. He got to within 170 miles of his objective.

Peary's successful expedition began in 1908. He travelled in his ship, the *Roosevelt*, as far as he could. Then he began the difficult overland journey. Shortage of supplies forced most of the team to turn back. Only Peary, Matthew Henson, his Negro servant, and four Eskimos went all the way. Another explorer later claimed to have reached the Pole first. But Peary's claim is officially recognized.

Peebles, originally called Tweeddale, is a small, mountainous, inland county of south-eastern Scotland with an area of 347 square miles. Its county town is Peebles, and its population is 13,700.

The county is situated in the Southern Uplands, and the mountains rise to a peak in Broad Law (2,754 ft). The region is watered by the river Tweed and its tributaries—the Lyne, Biggar and Eddleston. Forestry is a major occupation, and sheep farming is also important. Tweed and other woollens are manufactured in Peebles and Innerleithen. The superb scenery of wild moors, lakes and mountains attracts many tourists.

Peking (pop. 4,000,000) is the capital of China and the second largest city in the country after Shanghai. It is in the province of Hopei, close to the northern border with Mongolia. The city is the cultural and educational centre of China, with six universities and many academic institutions. Industry is developing in the eastern suburbs. The old or inner city, in the form of a square, is surrounded by stone walls broken by gates and high towers. Within the walls are many historic buildings. The city lies close to the

eastern section of the Great Wall of China which winds across the nearby mountains.

Peloponnesian War was caused by rivalry between Athens and Sparta, the leading city-states of ancient Greece. Sparta began the war in 431 B.C., and it lasted on and off for 27 years before Athens finally capitulated. Thucydides, the great Athenian historian, fought in the war.

Athens controlled a large empire and had many allies in the Delian League of city-states. The city was protected by walls and its navy ruled the sea. Sparta, for its part, headed the Peloponnesian League and had the more powerful land army. For these reasons, neither side could decisively beat the other. By 421 B.C. both sides were worn out and agreed to a truce. The Peace of Nicias, as it was called, lasted only until 413 B.C., when Athens resumed the fighting. Sparta finally enlisted the aid of Persia to help build up her fleet, and in 404 B.C. Athens was forced to surrender.

Pembrokeshire (area 614 square miles) a county in the extreme south-west of Wales, borders St. George's Channel in the west and the Bristol Channel in the south. Its county town is Haverfordwest, and its population is 101,200.

A rugged coastline cuts deeply inwards towards the Prescelly Hills in the north-east of the county. The principal rivers are the Teifi and the East and West Cleddau. Dairy farming and sheep rearing are the major industries in Pembrokeshire. But there is also some fishing, centred on Milford Haven, and tourism is on the increase. Oil tankers berth in Milford Haven's deep harbour to discharge their cargoes and Fishguard is a ferry station for travellers to Ireland. In 1951, most of Pembrokeshire's coastal region was made into a National Park.

Penang is a small but densely populated state in Malaysia. It consists of the island of Penang, off the north-west coast of the Malay Peninsula, and Province

A mosque in Penang. As in the other states of Malaysia, many of its people are Muslims.

Wellesley, a narrow coastal strip on the mainland. The climate, as elsewhere in Malaysia, is hot and damp, but it is rather cooler in the forest-covered hills of the island. The area of the state is 398 square miles, and its population is 777,000.

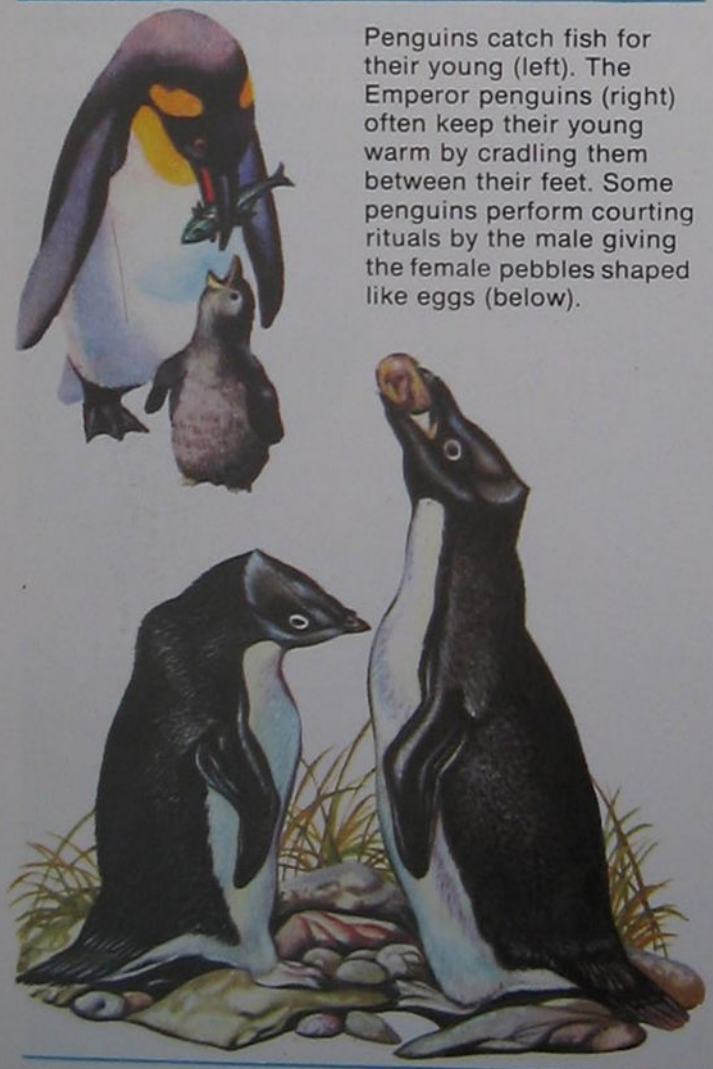
Penang's capital, George Town (often called *Penang*) is an important port. Many people in George Town work in the docks and ship-repairing yards or in factories that process rubber, tobacco, cement and other products. Elsewhere in Penang, people work on farms and plantations, cultivating rubber, coconuts and rice, or catching fish from small boats.

The British East India Company obtained Penang island from the sultan of Kedah in 1786, and acquired Province Wellesley 12 years later. Penang's location and well-protected harbour made it an ideal stop for ships trading in South East Asia. Britain made Penang the first capital of the Straits Settlements in 1826. Later, Singapore became the capital. During the 1800's and early 1900's many Chinese settled in Penang. Today, they make up over half the population.

Pendulum In its simplest form, a pendulum is a weight suspended at the end of a piece of string. If the weight is pulled to one side and released, it swings backwards and forwards through an arc of a circle. The time a pendulum takes to swing once is called its *period*. This time remains constant whether the arc is large or small and whatever the size of the weight. It depends only on the length of the pendulum. These facts were discovered by the Italian scientist Galileo. He suggested that the regular swinging of a pendulum could be used to control the movement of a clock.

Penguins are large, flightless birds, of which there are 14 or 15 species. They are found only in the southern hemisphere, mainly in Antarctic seas. From a distance, they look rather like fat little men in evening dress.

Although they cannot fly, penguins are excellent swimmers and divers. They are especially agile under water. On land, they stand upright and walk with a clumsy waddle. Their short, powerful, flipper-like wings look like arms. But the wing bones are flattened like paddles, and their webbed feet act as rudders. Because their legs are so small, and are set far back on their bodies, some penguins move



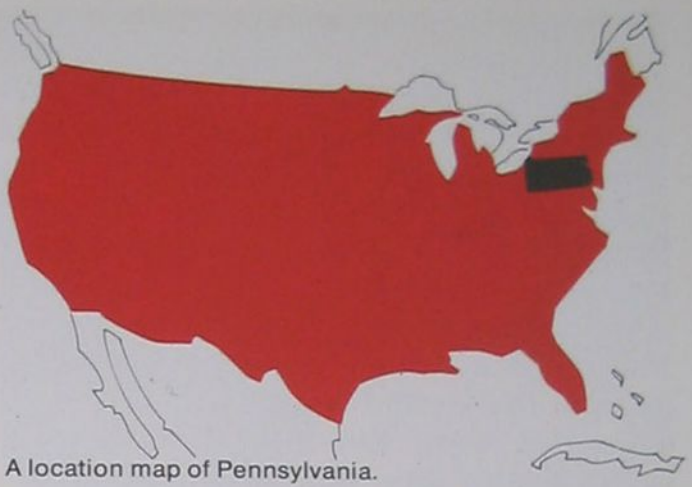
Penguins catch fish for their young (left). The Emperor penguins (right) often keep their young warm by cradling them between their feet. Some penguins perform courting rituals by the male giving the female pebbles shaped like eggs (below).

about on land by sliding down snowy slopes on their stomachs.

Penguins are covered with stiff, closely packed, oily feathers. These protect them from the cold, and also help to make the birds waterproof. There is also a layer of fat under the skin.

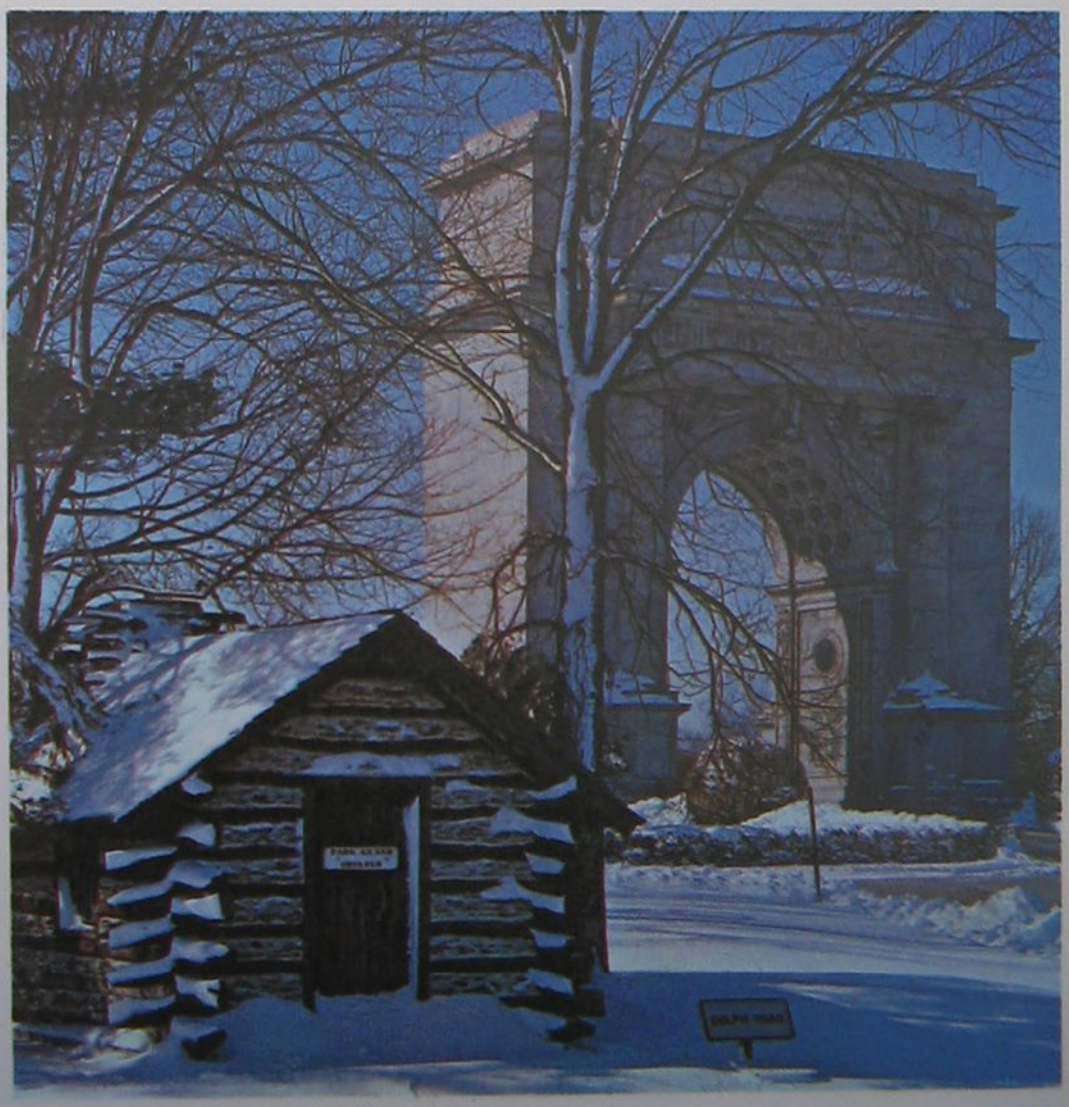
On land, penguins live in colonies, but these are usually so crowded that the birds have hardly any room to nest. The nests are built of sticks, stones and grass, and may be in the open, or hidden in cracks in the ground or under cliffs.

The two largest penguins, the emperor and the king, do not make nests, but incubate their single eggs while standing upright. The egg is placed on top of their feet and held in place by their belly. The male emperor penguin incubates the egg all by himself, and this means going without food for two whole months.



A location map of Pennsylvania.

Pennsylvania is an historic state in the north-eastern United States. With 11,794,000 people, it ranks third in population after California and New York. The state mines much of the nation's coal and Pittsburgh is the country's leading steel-producing city. Important products



The National Memorial Arch in Valley Forge, Pennsylvania was erected to honour the American forces who camped there during one winter of the Revolutionary War. General Washington's army was defeated at Philadelphia and Germantown and he decided to spend the winter of 1777 at Valley Forge. Washington's men had no supplies and had to build themselves log huts and shelters. Many men could not bear the cold and hunger, and deserted. About 11,000 troops stayed with Washington. At least 3,000 soldiers died at Valley Forge from hunger and disease.

of Pennsylvania's factories include processed foods, machinery and chemicals. The state is known for its industry. It is famous also for its beautiful Appalachian Mountain scenery and its peaceful farming communities. The chief agricultural products include milk, eggs, maize, oats, vegetables and tobacco. The state capital is Harrisburg, but the largest city is Philadelphia, which is one of the chief cities of the United States.

Swedes were the first Europeans to settle in the area that is now Pennsylvania. Then the Dutch controlled it. In 1664, it was seized by the British, who later granted it to the English Quaker, William Penn, after whose family the state is named. Philadelphia was already a leading town in colonial days. Both the Declaration of Independence and the United States Constitution were adopted there, and it served briefly as the national capital. Historic monuments at Gettysburg commemorate the famous Civil War battle that took place there. One of the best-known groups of people in Pennsylvania are the so-called *Pennsylvania Dutch*, descendants of German settlers.

Pepys, Samuel (1633-1703), is famous for the diary he kept between 1660 and 1669. It consists of more than a million words, and is a frank and often amusing record of the events of his daily life. It is also interesting for its description of life in London during the Great Plague of 1665 and the Great Fire of 1666. Pepys wrote much of his dairy in code, and it was not deciphered and published until the 1800's.

Pepys, a Londoner, was educated at Cambridge University. He rose from a clerkship to become secretary of the Admiralty in 1673. In this post, he did much to build up the power of the Royal Navy. He was a member of Parliament and President of the Royal Society.

'I went out to Charing Cross to see Major-General Harrison hanged, drawn, and quartered; which was done there, he looking as cheerful as any man could do in that condition.'

Samuel Pepys, 1660

Percussion instruments are drums and other musical instruments that make a sound when struck. They were the earliest musical instruments made by Man. Primitive peoples still use many different types of beating sticks, gourd rattles and stretched animal-skin drums to accompany dances and ceremonies.

The conductor of an orchestra usually places his percussion section at the back. Among the standard instruments used are the *kettle drum, snare drum, bass drum, xylophone, cymbals* and *triangle*. Besides these, other instruments are sometimes used for special effects. *Castanets*, for example, are hand-held wooden clackers, characteristic of Spanish gypsy and flamenco music. The *tambourine* is a one-sided hand drum with metal discs around the rim, which sound when the instrument is hit or shaken. In Latin American music the players frequently use *maracas* (seed-filled shakers), wooden *rumba sticks*, and a *marimba*, a large instrument similar to the xylophone. The *gong* produces a half-muffled sound.

Most percussion instruments have no definite pitch (highness or lowness of tone). They are used to produce a crashing, banging, scraping or knocking sound. The *cymbals*, for example, are metal discs that are brought together to give a clashing sound. Different sizes of cymbals produce different tones. The smaller *snare drum* is tapped with plain sticks. It gives a snappy, sharp sound. The huge *bass drum* is played with padded sticks and gives a deep, rich tone.

Some percussion instruments, however, do have a definite pitch. The *timpani* or *kettle drums* are a pair of large drums whose heads can be tightened or loosened by means of screws to change the pitch.

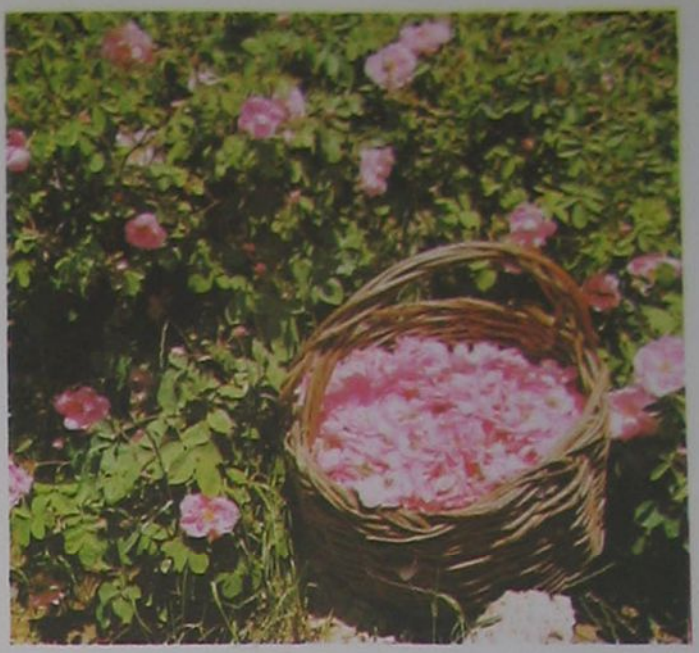
The *xylophone* has graduated metal strips, each corresponding to a different note. These are hit with metal hammers.

The *glockenspiel* is a smaller instrument similar in principle to the xylophone. It produces a bell-like tone.

Percussion instruments form part of the rhythm section of a band. They are an essential part of military bands, dance bands, rock groups and jazz combos. The drummer's set in a band usually consists of a bass drum and pairs of cymbals, which he plays with a foot pedal. He plays a smaller drum with either sticks or wire brushes.

Perennial plants are plants whose lives cover several growing seasons. Herbaceous perennials—those with non-woody stems—generally die down above the ground each autumn after producing flowers and seeds. The underground parts, packed with food, see the winter through. Woody perennials—shrubs and trees—maintain a shoot system above the ground all the year round.

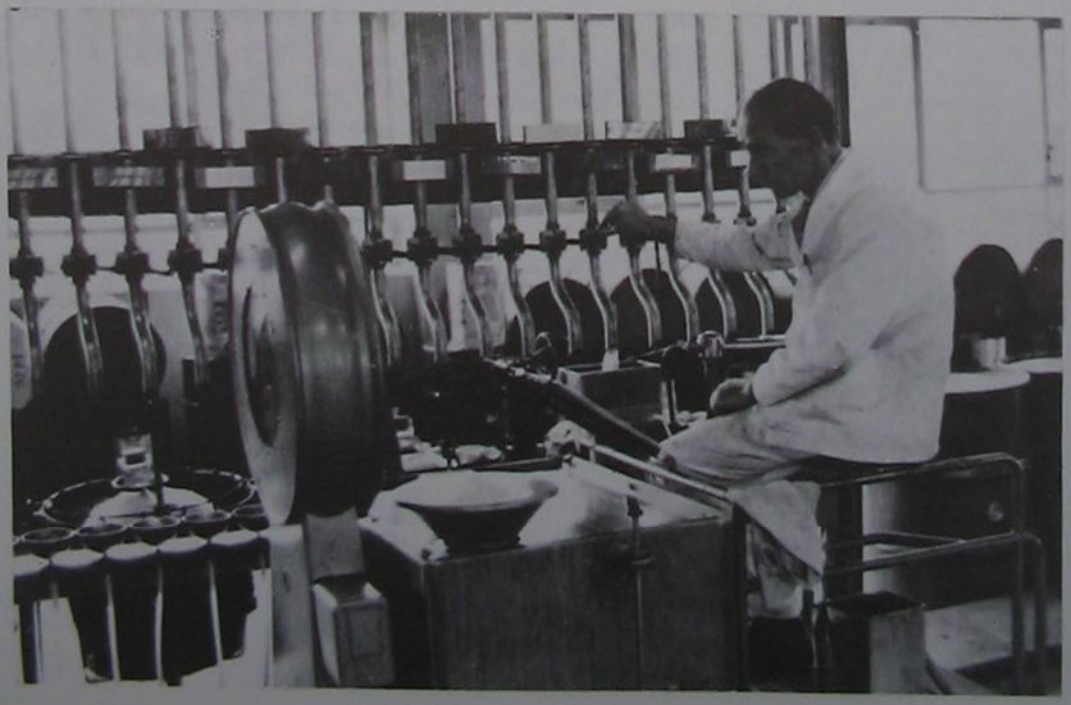
Perfume The delightful fragrance of flowers such as roses comes from substances called *essential oils* stored in their petals and sometimes other parts, too. These oils are often extracted for use as perfume. Certain animals also produce substances which can be used as perfume. But many perfumes today are synthetic, or man-made.



Bulgarian rosepetals for the perfume attar of roses.

Among plant perfumes, attar of roses is outstanding. It is made by distillation—boiling rose petals in water and condensing into liquid the vapour produced, which is the essential oil. Most plant perfumes are made by distillation.

Most animal perfumes come from glands in the animal's body. Civet comes from the Abyssinian civet. Musk comes from the musk-deer. Castor comes from the Canadian beaver. But one of the most powerful animal perfumes, ambergris, is produced in the intestines of the sperm whale as the result of illness.



Left: A perfume organ which is used in perfume making. Each pipe contains some ingredient which is used in perfumes. The pipes have stopcocks so that the ingredients can be measured like water from a tap.

The word perfume comes from the Latin per fumum, 'through smoke', recalling that perfumes were first produced by burning sweet-smelling resins or woods.

Toilet waters such as eau-de-Cologne are weak water-alcohol solutions of the perfume.

Periscopes are instruments used to see over walls and around corners; in fact the prefix *peri-* means 'around'. A simple periscope can be made using two plane mirrors set at 45° to the axis of a long tube.

The periscope used in a submarine has prisms instead of mirrors. Light rays entering the prisms strike the inside of the back faces at angles *less* than the *angle of internal reflection* (see Mirage). When this happens the rays are *reflected* from the inside surfaces instead of passing out of the glass through them. Submarine periscopes also have lenses to enable them to be used as telescopes.

Persia, a large kingdom in south-western Asia, is officially named Iran.

Central and eastern Iran is a plateau lying 4,000 feet above sea level. The plateau contains a rocky, sand desert and a desert of salty lakes and swamps.

The captain of a submarine locates ships through the periscope, the top of which is above the waves.

Ruins at Persia's magnificent ancient city, Persepolis.

The Zagros, Central, Elburz and other mountain ranges surround the plateau.

The country has little rain, but snow caps many of its mountains, creating streams that disappear into the central deserts. Temperatures range from below freezing to above 130° F (54° C).

Persians are mainly Muslims of the Shiite sect or Sunnite Muslims, Christians, Jews or Zoroastrians. The modern way of life in Tehran, the capital, contrasts with conditions in south-eastern Persia.

Most Persians are farmers who grow mainly wheat and barley. But only one-seventh of the land is suitable for crops. Persia has few manufacturing industries, but Persian carpets are world-famed.

Cyrus the Great united the Medes and Persians in 547 B.C., and founded the Persian Achaemenian empire. By 405 B.C., this empire extended from Bulgaria to India, and from northern Africa to central Asia. The Persians conquered the rival civilizations of Babylonia, Assyria and Egypt.

The Persians did not usually oppress conquered peoples but borrowed and adapted their culture. They built splendid cities, including Persepolis, now ruined. Alexander the Great's Greek armies destroyed the Persian empire in 330 B.C.

Arabs took Persia in A.D. 661, and replaced Zoroastrianism by the Islamic religion. Mongol horsemen swept into Persia in the 1200's. The old Persian capital of Isfahan was the centre of a flourishing culture under Shah Abbas the Great in the 1660's. Soon after, it declined. In 1925, Riza Shah Pahlevi founded a new dynasty. In 1941, he was succeeded by his son, Mohammed Riza Shah Pahlavi. In 1963, the Shah brought in a programme of reforms that did much to modernize Persia. These included the distribution of land to the peasants and the granting to women of the right to vote.

Facts and Figures
Area: 636,294 square miles.
Population: 28, 622,000.
Capital: Tehran.

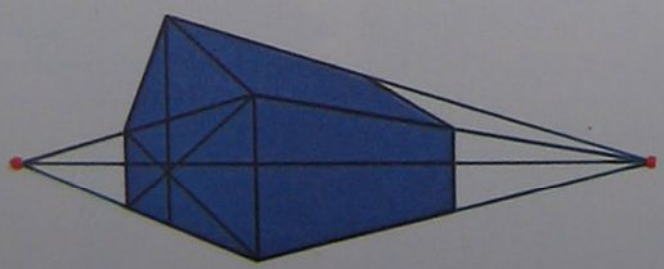
Top: Iranian women pick tea on a plantation.

Right: Location map of Iran.

Below: A game of polo from a Persian manuscript, dating from A.D. 1480.

Perspective Any method of depicting three-dimensional space on a flat surface is known as *perspective*. In a drawing or painting it gives the viewer an impression of an object, or scene, in depth, when seen from a given point. The basic method used is to make all the lines and surfaces of the scene converge upon a single point known as the *vanishing point*. Modern perspective is usually assumed to have been invented in 1420 by Brunelleschi.

Perth is the capital of Western Australia. It lies on the banks of the Swan River, 12 miles upstream from its port, Fremantle. Perth lies in a prosperous agricultural region whose products pass through the city, while its industries include wool manufacturing and engineering. Fremantle is the first or last call on the shipping route to Europe, and plays an important part in the city's prosperity.



Artists use perspective and vanishing points to draw a realistic picture of a house.

Perth has a population of 701,400 and is one of the smallest of the Australian state capitals. It has one of the most pleasant climates in the country—temperatures average about 73 °F (23 °C) in summer, and about 55 °F (13 °C) in winter. There is an average of eight

This view of Perth shows the city in the foreground and the port of Fremantle on the coast (top left).

hours' sunshine a day. Perth is a well planned city, surrounded by suburbs and including King's Park, a thousand-acre area of natural bushland.

The oldest parts of Perth are on the northern shores of Perth Water and Melville Water, two small lakes formed by the Swan River. At first the settlement's growth was slow, but the arrival of convicts in 1850 speeded it up and it became a city in 1856. The discovery of gold at Kalgoorlie and Coolgardie in the 1890's brought more settlers, and Perth had a population of over 70,000 when Western Australia became a state in 1901.

Perthshire (area 2,495 square miles), an inland county of central Scotland, is a mountainous region of great beauty. Its county town is Perth, and its population is 125,000.

The Grampian Mountains make up much of Perthshire. There are 50 peaks over 3,000 feet; Ben Lawers, at just under 4,000 feet, is the highest.

Cattle are reared and sheep grazed on the lowlands of Strathmore. Oats, root crops and fruit are cultivated, but the main industry is tourism. Beautiful *lochs* (lakes), and wooded *glens* (small, narrow valleys) such as the Trossachs, attract thousands of anglers and climbers. The main resorts are Crieff, Dunblane, Callander and Pitlochry.

Peru is a country in north-western South America. The narrow coastal strip, where many of the cities lie, has some fertile river valleys, but is mainly desert. Snow covers the tall peaks of the Andes mountains, which border the coastal strip (see Andes). Between the ranges of the Andes are plateaux (high plains). At 12,500 feet above sea level, on the Peru-Bolivia border, lies Lake Titicaca, which covers 3,260 square miles.

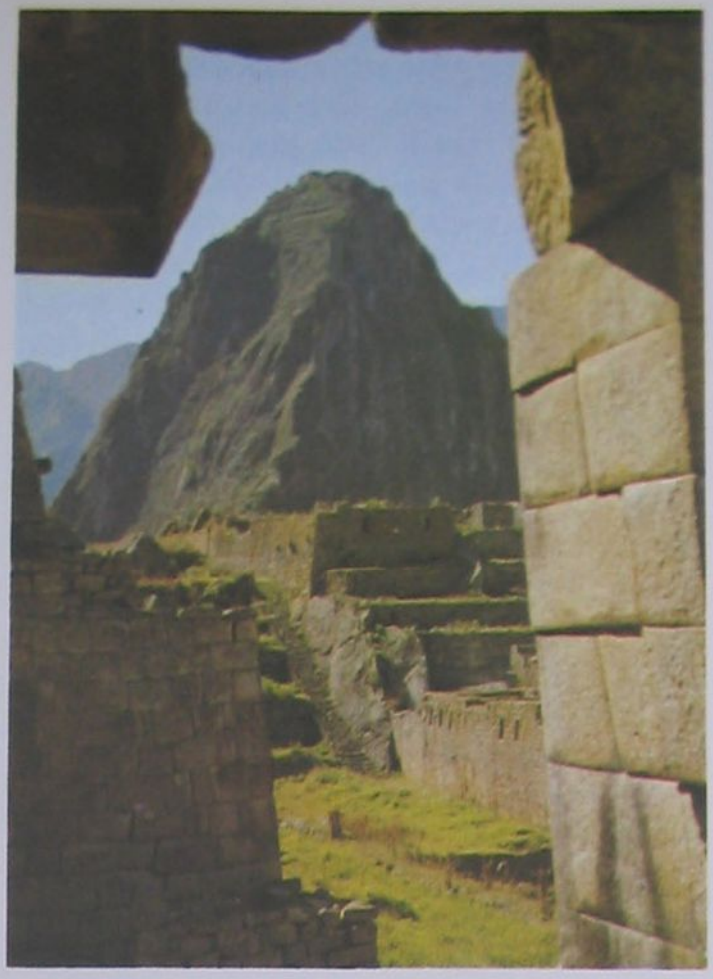
East of the Andes, the land slopes down to a thickly-forested plain. Many rivers, which join the mighty Amazon River in the north-east, flow across this plain (see Amazon). The plain has a tropical hot, wet climate. In contrast, the mountains are cool and the coastal region is dry. Temperatures along the coast are not high, because of cool winds that blow from the sea. These winds are cooled as they pass over the cold Humboldt Current, a cold stream of ocean water flowing from the Antarctic.

The mountains of Peru contain many minerals, including bismuth, copper, iron ore and gold. More than half of the people live in the mountain region. The rest live mainly along the coast. Only a few *Amerind* tribes (South American Indians) live on the hot plains. About half of Peru's people are Amerinds. Most of the rest are *mestizos*, people of mixed European and Amerind ancestry.

The mountain Amerinds rear cattle, llamas and sheep. Some work in the mines. The coastal people work on small farms or on plantations, growing cotton and sugar for export. *Guano*, sea-bird droppings, is collected from Peru's offshore islands. It is a valuable fertilizer.

Peru was part of the Inca empire from about the 1100's until it was conquered

Facts and Figures
Area: 496,223 square miles.
Population: 13,600,000.
Capital: Lima.
Money Unit: sol.
Labour force: 65% rural; 35% urban.
Exports: copper, cotton, fish products, iron ore.
Imports: chemicals, foodstuffs, machinery.



Left: Machu Picchu is a well-preserved Inca city in Peru. Probably built in the 1400's, the city was unknown for several hundred years before it was discovered in 1911.

Right: An old Peruvian farmer wears warm clothes to protect him against the cool mountain climate.

Below: Peruvian women work in the fields.

Right: Recalling the past glories of the Inca civilization of South America, these Peruvians are wearing Inca head-dresses during a festival.

Below: Peru faces the Pacific Ocean in north-western South America.

by Spain in the 1530's (see Incas). After several uprisings, Peru became independent in 1824. An army of Colombians and Venezuelans, led by Simón Bolívar, a Venezuelan revolutionary, overthrew the Spaniards. Later in the 1800's, Peru had minor wars with its neighbours and with Spain. Mainly under military rule since then, Peru has had much internal unrest.

Pet Millions of people all over the world get pleasure from pets. They can be loyal and affectionate companions for their owners.

Man's earliest pets were probably the dogs that prehistoric people tamed and kept as hunting companions. The ancient Egyptians tamed hyenas for the same purpose. The Egyptians considered cats to be sacred animals, but they also used them to chase mice and rats out of their granaries. People in the Middle Ages tamed falcons and other birds of prey and used them to hunt. The training of these fierce birds was a long and difficult task needing much patience.

In many countries, dogs are the commonest pets. They seem to enjoy being with people as much as people enjoy being with them. There are many different breeds and sizes of dogs to choose from. For a city family, a small dog is often the best choice. Large dogs need plenty of room to exercise, and are happier in the country than in a town. Dogs are clean by nature, but they need to be house-trained while they are puppies. They must be fed properly, given plenty of exercise and brushed regularly. They quickly learn to obey commands and even to do tricks.

Cats are also popular as pets, though they have a reputation for being more independent of their masters or mistresses. Cats are very graceful in their movements and are beautiful animals to watch. They house-train very easily. Other intelligent

A pair of beagle puppies. These endearing dogs make good pets, but need plenty of care and exercise if they are to be fit and happy.

animals that people keep as pets are otters, monkeys and chimpanzees, but these are much less common.

Smaller animals, such as birds, are suitable where space is limited. Parrots, budgerigars and mynah birds are among the birds that can be taught to imitate human speech. Canaries and other songbirds are pleasant to listen to. Hamsters, gerbils, guinea pigs and mice live comfortably in cages so long as they have enough food and water and some means of exercising, such as a wheel to run on. They sleep in wood shavings or other soft material. Fish are also popular pets. A well laid-out aquarium, with plants and rocks and bright fish gliding around, is interesting to watch. But it requires some effort to set up and it must be kept properly. Tropical fish, for example, need heated water in their tank, an air bubbler and filtering system. But once this is done they need little else except food.

Children who live in the country can make pets of all kinds of animals, including young lambs and goats, rabbits, chicks and ducklings.

Talking points

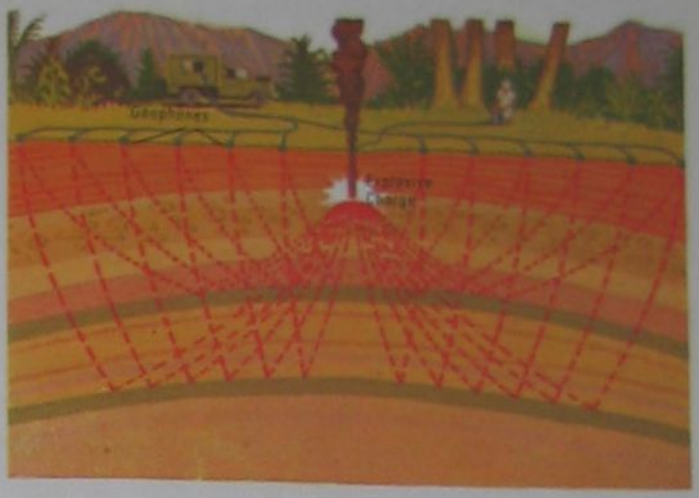
* Kittens and puppies make charming and lovable pets, and are often given to children as presents. Unfortunately, when they grow larger, many of them are abandoned or destroyed. Why do you think that this happens?
* Cats like to roam about and dogs, especially large ones, need a lot of exercise. Do you think that these animals should be kept as pets in towns?
* Some pets are kept for a purpose, such as cats for catching mice. Discuss why people keep pets that are not useful in any practical way.

Articles to read

Aquariums; Cats; Dogs.

Petroleum is one of our most important fuels, and the petroleum industry is one of the largest in the world. The United States, Russia and Venezuela are the largest producers. Countries in the Middle East also produce large quantities, and they have the greatest known reserves of petroleum, too.

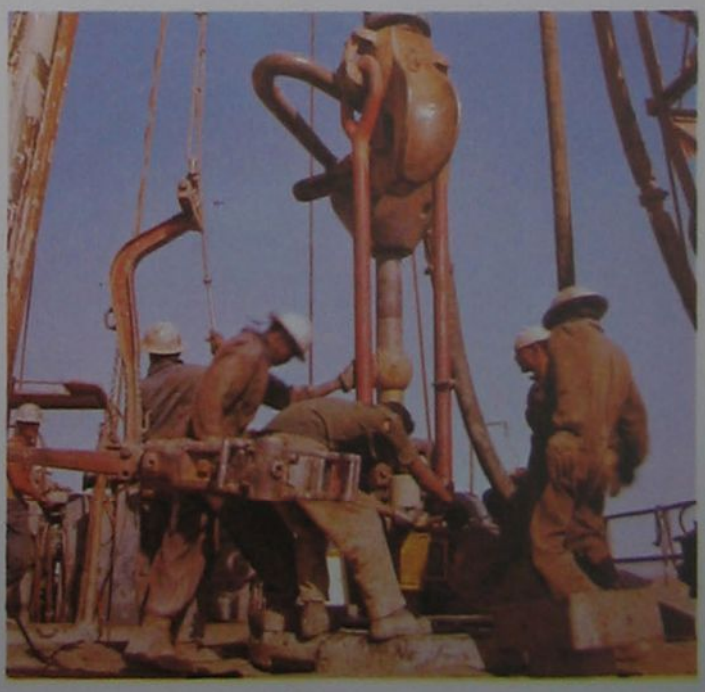
By refining crude petroleum in various ways, we obtain petrol, or gasoline, for our automobiles; fuel oils for heating and producing power in ships, industry and diesel engines; kerosene (paraffin) for jet and rocket engines and for home heating; and all kinds of oil and greases to lubricate machinery. In addition, we obtain a host of useful chemicals, called *petrochemicals*, by processing petroleum.



Seismographs are used in oil exploration. Shock waves caused by an explosion are reflected back to the ground from the surfaces between the different layers of rock. In the picture, an anticline (upfold) has been found.

Petroleum, often simply called oil, is a complicated mixture of substances called *hydrocarbons*, which are compounds of hydrogen and carbon only. It was formed millions of years ago from the remains of animals and plants, which lived in the seas.

Drilling for petroleum in the Libyan desert. Since it was found here in the 1950's, petroleum has brought great wealth and improved living standards to Libya.



The remains decayed and were buried by layer upon layer of mud and sand, which turned into rock. Heat, pressure and decay changed the remains into drops of oil and also natural gas.

A lot of the oil and gas worked its way through porous rock to the surface and escaped. But much was trapped in non-porous rock layers.

In a fault trap, oil has accumulated behind a wedge of non-porous rock which has slipped down into the oil-bearing rock layer. Oil may also be trapped in the top of a rock fold or where an oil-bearing layer tapers to a wedge. It may also collect on top of huge domes of salt thrust up from deep underground.

Prospecting, or looking for petroleum is a skilled job. Oil geologists do not look for oil directly but they try to find traps in which oil may lie. They use a variety of instruments to help them, including *magnetometers* and *gravity meters*. But their most useful instrument is the *seismograph*. The oil prospector sets off an explosion and records the vibrations at various distances by seismograph. This will tell him the shape and depth of underlying rocks.

When the oilmen decide to drill for oil, they set up a tall derrick to hoist equipment into the drill hole. Most oil wells are bored by rotary drilling. The drill consists of lengths of pipe joined together, with a sharp cutting bit at the bottom. A steel turntable on the derrick floor grips and turns the pipe. A liquid drilling mud is pumped through the pipe to cool the bit and to flush out rock cuttings. The well is lined with casing as it is drilled.

When oil is found, it usually flows to the surface naturally. Water below, or compressed gas above, pushes the oil out of the well.

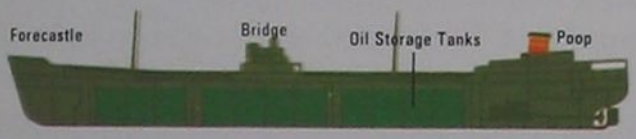
The crude oil is taken from the wells to oil refineries, often in different countries, to be processed. Pipelines and tankers are means of transporting the oil.

At the refinery, the first step in processing is *distillation*, or *fractionating*, which separates the crude oil into its constituents, or *fractions*. The oil is heated in a furnace and passed into a fractionating column. The fractions separate into different trays in the column according to their boiling points. Petrol and light oils condense at the top, heavy fuel oils at the bottom.

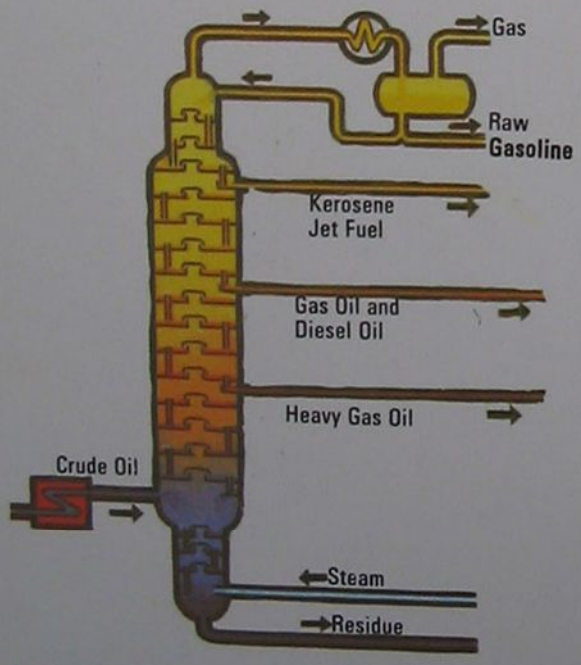
The heavy oils can be *cracked*, or broken down into more useful products such as petrol. In thermal cracking, they are broken down by heat and pressure. In catalytic cracking, they are heated with a catalyst—a substance which helps the reaction but does not itself change.

The gaseous fractions from the column and from cracking can be 'built up' into petrol. *Polymerization* and *alkylation* are processes in which the small gas molecules combine to form larger ones.

Below: A cross-section of a typical modern oil tanker shows how much space is devoted to the storage of oil.



In the primary distillation process, hot crude oil is fed in at the foot of the fractionating column and mixed with steam. Various constituents, or *fractions*, of the crude oil separate at various points of the column.



Above: Petroleum is found in many parts of the world. This tall oil derrick is in Alaska, in north-western North America. Alaska is part of the United States, which is the world's leading petroleum producer.

Below: A de-gassing station seen through a heat haze caused by flares from burning gas.

These gases are also used as a starting point to make petrochemicals. They are converted into plastics and synthetic rubber, solvents for paints, antifreeze mixtures, and man-made fibres.

Pewter In the 1600's and 1700's, pewter was widely used to make jugs, dishes, tankards and other tableware. It was used as an inexpensive alternative to gold and silver plate. Very little pewterware is made today. Pewter is a metal alloy which contains mainly tin together with some copper and antimony. It is quite soft and can be shaped easily. But it dents and scratches readily.

Phillip, Arthur (1738-1814), a British naval officer, was the founder and first governor of New South Wales.

In the late 1700's, Britain's prisons were badly overcrowded. The government decided to transport some of its convicts overseas, and Phillip was appointed to

command the first penal convoy to Australia. He arrived in Botany Bay in January 1788, with 11 poorly equipped ships. After a week he decided that the site was unsuitable and moved on to Port Jackson (later renamed Sydney). Conditions were harsh for the first two years, and the settlement nearly died from starvation. Phillip managed to establish a self-supporting colony, but the strain told on his health and he retired to Britain in 1792. He was promoted to admiral shortly before his death.

Philippines, a country in south-eastern Asia, consists of more than 7,000 islands. Manila is the country's largest city.

The main islands are Luzon in the north and Mindanao in the south. About 6,600 islands each cover less than a square mile. Most are uninhabited. The Philippines is a mountainous country with a tropical, humid climate: Earthquakes and typhoons are common. The islands have a rich variety of plant and animal life.

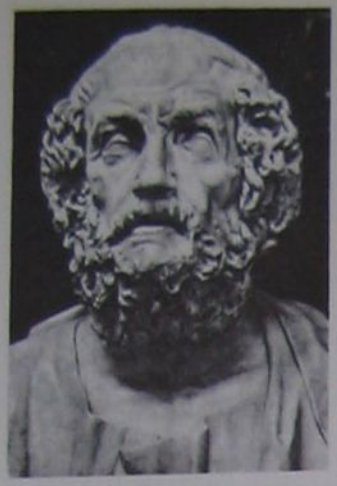
The people of the Philippines are called Filipinos. Most Filipinos look rather like Chinese, but have light brown skin. Many are Roman Catholics. The official languages of the country are Filipino, English and Spanish.

Seven-tenths of all workers are farmers, but only about a fifth of the land is cultivated. Rice, sugar cane and coconuts are leading crops. Timber is exported and fish are plentiful. The country's mineral wealth includes gold and silver.

People from the Asian mainland settled in the islands before 2000 B.C. Chinese and Japanese traders reached there by A.D. 700, and the Arabs by 1400. Spaniards colonized the islands from the 1500's onwards. Despite revolts, they stayed until 1898, when the United States seized the islands after a war. Japan occupied the area in 1941-1945. In 1946, the country became independent. It has a democratic government, based on that of the United States, with a Senate, a House of Representatives and an elected president.

The Philippines consists of more than 7,000 islands in the western part of the North Pacific Ocean. Above: A Filipino girl gathers crops. Below: Workers plant rice in the wet paddy fields. The Philippines is one of the world's leading rice producers.

Facts and Figures
Area: 115,707 square miles.
Population: 38,000,000.
Capital: Quezon City (on Luzon).



Born in Athens, Greece, in about 427 BC, Plato became one of the greatest philosophers of all time. Plato was taught by Socrates, whose ideas he developed. Plato's written dialogues are masterpieces of philosophy.

Philosophy means the study of knowledge in the widest sense, and comes from Greek words meaning 'love of wisdom'. There are, however, many branches of knowledge and many approaches to its study. Philosophers have enquired into human conduct and tried to solve moral questions of what men ought to do and how they ought to behave. They have also pondered the whole question of methods of knowledge, and tried to decide what men may expect to know and how they may carry out their studies.

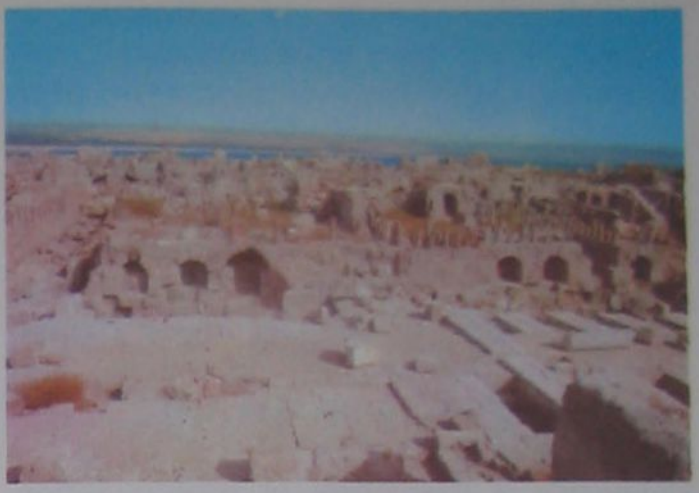
Much of the ground covered by earlier philosophers has now been taken over by science, and philosophy is now mostly concerned with matters that science does not deal with, such as ethics and beliefs. In general, philosophers take nothing for granted, but try to understand and express ideas, and find order and meaning in the universe.

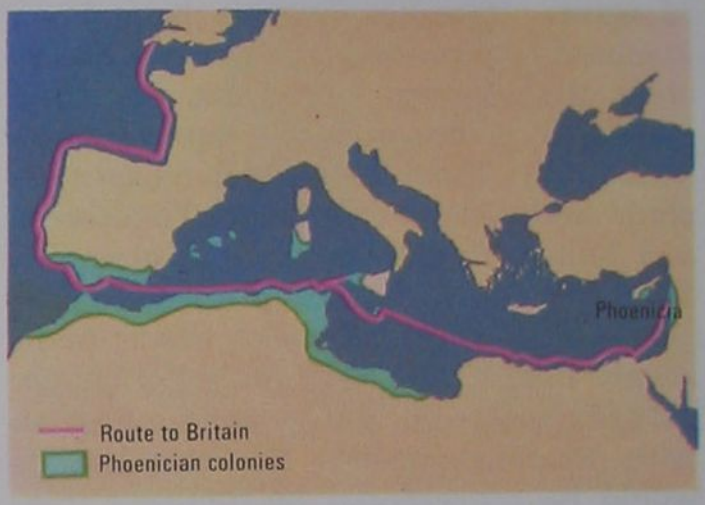
Phoenicians The Phoenicians lived on the coast between the Mediterranean Sea and the mountains of Lebanon. The first settled there at some date before 2500 B.C.; and founded five main cities, of which Tyre and Sidon are the most famous. The Phoenicians lived by trade. Goods from Mesopotamia, Egypt, Greece and North Africa were bought and sold. They also produced goods of their own for sale, particularly timber from the cedar and laurel trees of Lebanon, a purple dye from a shell fish, wine, oil, textiles and other manufactured goods.

Their land became part of successive Empires – Egyptian, Assyrian and Babylonian – but at some time in the eighth century B.C. the Phoenicians began to sail west into the Mediterranean and establish trading settlements. They set up colonies in Sicily, Spain and North Africa (see Carthage), and even passed

FAMOUS PHILOSOPHERS

Confucius	Chinese	c.551-479 B.C.
Socrates, Aristotle, Plato	Greek	5th-4th c. B.C.
St Augustine	Numidian	354-430 A.D.
Averroes	Spanish/ Arabian	1126-1198
René Descartes	French	1596-1650
Jean Jacques Rousseau	French	1712-1778
Ralph Waldo Emerson	American	1803-1882
John Stuart Mill	British	1806-1873
Karl Marx	German	1818-1883
Friedrich Nietzsche	German	1844-1900
Bertrand Russell	British	1872-1970





The ruins of Tyre face the Mediterranean Sea on the Lebanese coastline. Tyre was one of the greatest of the Phoenician coastal cities. From it, the Phoenicians sailed through the Mediterranean trading and establishing colonies, as shown on the map. The map shows that one of their routes took them to Cornwall, in Britain.

through the Straits of Gibraltar to Britain. Their two most important contributions to human development were their skill in sailing and their use of the alphabet. The Phoenicians developed this from the ideas of a neighbouring tribe. The Greeks took the alphabet over and the Romans adopted it. The cities of Tyre and Sidon prospered under Roman rule. Muslims overran Phoenicia and the rest of Syria in the A.D. 600's.

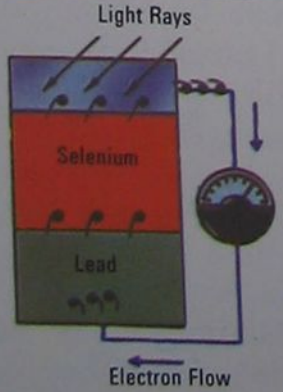
Phonetics is the study of pronunciation of words. Phonetic symbols have been invented to represent sounds more accurately than groups of letters. In some languages, groups of letters represent one sound only. These *phonetic* languages include Serbo-Croat (spoken in Yugoslavia) and Italian. English is far from phonetic. The letters *ough*, for example, can be pronounced in many different ways, as in *rough, bough, through, although, cough, thought*, and so on. But by writing English with phonetic symbols, all these sounds would be represented by different symbols. In America, English spelling is sometimes changed to make pronunciation easier. For example, *colour* is spelt *color* in America.

Photocell This device makes use of the *photoelectric effect*. A photocell normally consists of some form of semiconductor material (see Transistors). A popular material is selenium. This gives an electric potential that varies as the brightness of the light falling upon it varies. Photocells are sometimes used in burglar alarms. The selenium or similar material is mounted in a glass container and connected in some way with an alarm circuit. An invisible infra-red beam shines on it. If an intruder enters the room, he breaks the beam: it no longer illuminates the photocell and so the electrical potential of the selenium changes and sets off the alarm.

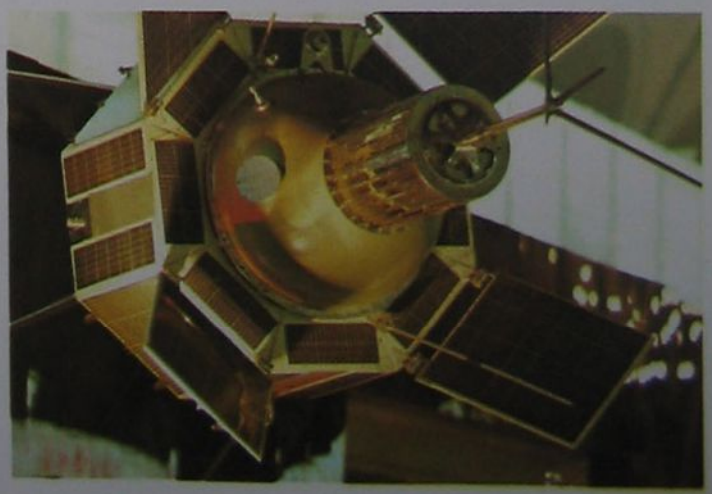
There are other semiconductor materials that generate a voltage when a light shines on them. Photographers' light-meters often use materials of this sort. The voltage generated increases as the brightness of the light increases. It drives a current through a small meter which shows the light value. The more sensitive type uses cadmium sulphide, whose electrical resistance varies with the intensity of light.

Materials like these are used to power many of the artificial satellites and experimental space-probes sent out by the U.S.A. and the U.S.S.R. Large numbers of individual cells are arranged around the body of the satellite or are mounted on 'paddles' that extend out from the satellite and are kept pointing towards the Sun, which supplies the light.

Photography The photographs in this book give us more information about the objects, ideas, people and places we read about. Photographs are used for this purpose in all kinds of books, magazines and newspapers. They are normally taken



Photoelectricity is used in photographers' light meters. The light meter consists of a photocell in circuit with a galvanometer. The diagram shows how a flow of electrons (an electric current) is produced when a photocell in a circuit is exposed to light.



Space satellites, such as the Sputnik (right) are powered by photocells.

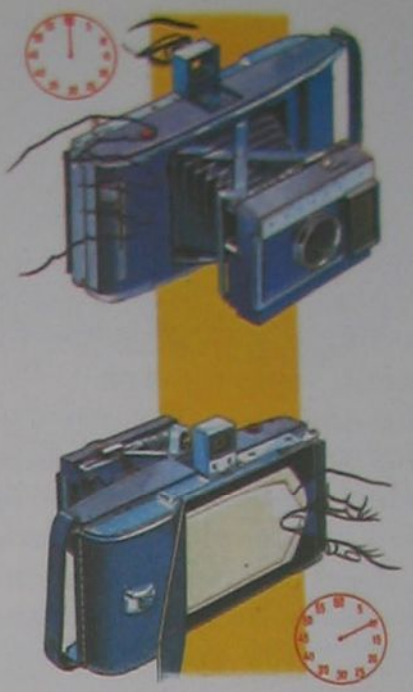
by professional photographers who sell the reproduction rights to the publisher.

But photography is far from being purely a professional occupation. It is also one of the most popular hobbies in the world. Few holidays would be complete without a record in photographs of where we went, whom we met, and what we did.

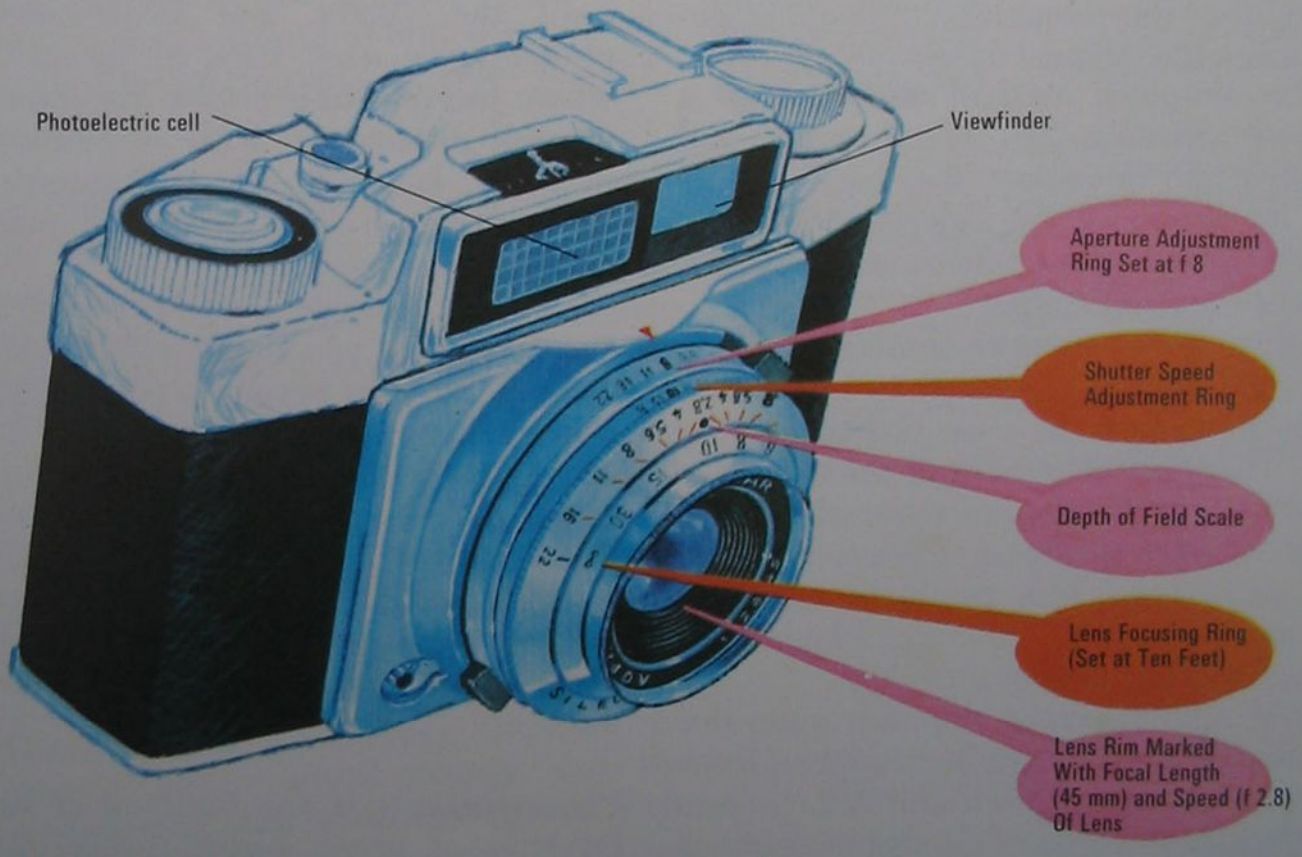
A photograph is taken with a camera by pressing a button, which releases a shutter over the glass lens. Light passes through the lens and forms an image on the film inside the camera. (See Camera.)

The film is a long, transparent plastic (cellulose acetate) strip covered with a light-sensitive coating called an *emulsion*. The emulsion is made up of minute grains of silver bromide and iodide in gelatine. When light falls on the silver salts, they change chemically according to the amount of light falling on them. In this way, they record the scene taken.

A visible image of the scene is obtained by treating the silver salts with chemicals. This process is called *developing*.



Top: The Polaroid Land J66 Camera in use. Ten seconds after moving the film on, the print can be lifted out. Bottom: An Agfa miniature camera showing various adjustments. The aperture is set at stop f8 and the lens is focused on an object ten feet away. The marks opposite the f8 positions on the depth of field scale, show that the depth of field is from 8 to 15 feet.


Photoelectric cell
Viewfinder
Aperture Adjustment Ring Set at f 8
Shutter Speed Adjustment Ring
Depth of Field Scale
Lens Focusing Ring (Set at Ten Feet)
Lens Rim Marked With Focal Length (45 mm) and Speed (f 2.8) Of Lens

First the film is put into a developer, a solution which changes the exposed salts into metallic silver. The exposed areas therefore become dark. Then the film is washed in water (the *stop bath*) to remove excess developer.

Next, the film is treated with a *fixing solution,* usually sodium hyposulphite, to remove the unexposed silver salts. The unexposed areas are therefore transparent. After washing and drying, the film holds a permanent, visible image.

But the image is the reverse of the scene photographed. Bright areas in the scene, which reflected much light into the camera, are developed to dark patches of silver. Dark areas in the scene, which reflected little light, become almost transparent. This reversed image is called a *negative.*

The negative is changed into a positive image by the process of printing. In printing, a bright light is shone through the negative onto a piece of printing paper, which has a light-sensitive emulsion like a film. In the same way as before, the image formed is developed to produce a reverse image of the negative. Reversing the negative, of course, reproduces the original scene.

The simplest method of printing is *contact* printing, in which print and negative are in contact. But larger prints can be produced by *enlarging.* An enlarger throws a magnified image of the negative onto the paper.

Colour films are more complicated and more difficult to process than black-and-white films, but they are just as easy to take. There are two kinds of colour film—negative and positive, or reversal. Colour negative film produces coloured prints. Colour reversal film produces coloured transparencies, or slides, which are viewed through a projector.

Colour photography depends upon the fact that all colours can be produced from a mixture of blue, green and red. Colour film has three layers of emulsion sensitive to blue, green and red light respectively.

The amateur photographer may make many mistakes. Among the most common are underexposure and overexposure. The photograph taken at Berlin Zoo (left) is underexposed and appears dark. The photographs of the yacht and of Copenhagen (below) are overexposed and are far too light in colour.

Processing involves developing and dyeing the images in each layer.

Colour photography was not perfected until the 1930's. But black-and-white photography goes back as far as 1826, when Joseph Niépce took the first permanent photograph with an emulsion of bitumen. In 1839, Louis Daguerre and William Fox Talbot developed practical photographic processes.

In 1888, George Eastman marketed a simple camera which amateurs could use, and photography became a popular hobby. The first miniature camera, the Leica, appeared in 1924. It used 35-millimetre film—the same size used for cinema films. In 1947, Edwin Land introduced his Polaroid Land camera. This camera not only takes photographs but develops and prints them as well in less than one minute.

Photosynthesis is the building of sugars by cells of green plants, using energy derived from the Sun. Only green plants

are able to make their own food. Consequently, they are the basis of all life on Earth. Some animals eat plants, and other animals eat the animals that ate the plants. In this way, the energy originally captured and transformed into food by plants is distributed throughout the living world.

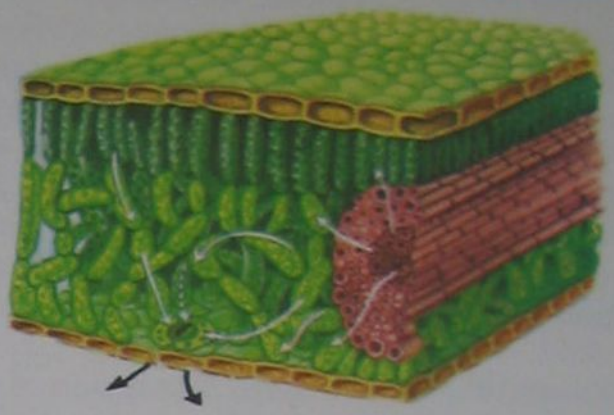
The raw materials for photosynthesis are carbon dioxide and water, and the primary regions of sugar production are the cells of the leaves. Leaf cells are packed with envelopes of green colouring matter called *chlorophyll*, which is essential to photosynthesis. It absorbs light energy and converts it into chemical energy. This chemical energy is then used to build up the sugar in the leaf. It is a complex process, still not fully understood, but the end result is that the carbon dioxide and water produce sugar and oxygen.

The oxygen produced by photosynthesis escapes into the air. In this way, green plants are continually 'refuelling' the air with oxygen—the gas vital to animal life. If all the green plants were to die, animals would eventually use up the supply of oxygen in the Earth's atmosphere.

Physics is one of the major sciences. Physicists study such things as sound, light, heat, force, motion, electricity, magnetism, and atomic and nuclear reactions. They use mathematics a great deal in their work.

Pianoforte (meaning *soft* and *loud)* is the correct term for a piano. The piano was invented by Bartolomeo Cristofori of Italy in 1709, and given its name because it was the first keyboard instrument allowing much difference between loud and soft. There are two main types of piano: the *upright* with vertical strings and the larger *grand* with horizontal strings. Both of them were developed in the 1800's and have changed little since then.

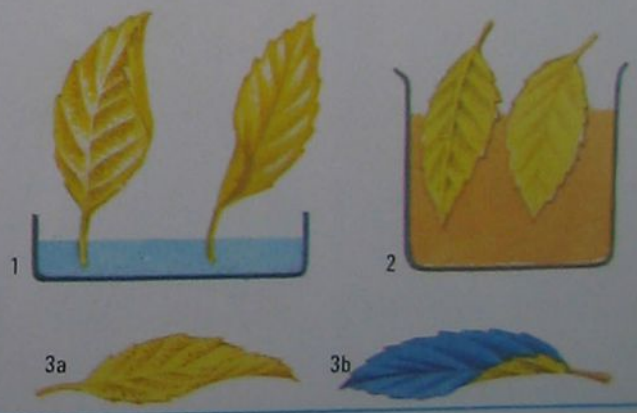
The piano keyboard usually has 88 keys.



This block diagram of part of a leaf shows how water passes from the veins into other leaf cells and out through the pores or stomata.

In bright light, carbon dioxide enters the leaf because photosynthesis needs more than the small amount produced by respiration. More oxygen is produced than respiration consumes, so oxygen passes out. In dim light, the exchange of gases is balanced. Respiration produces enough CO_2 for photosynthesis and the latter produces enough O_2 for respiration. In the dark, photosynthesis ceases. Oxygen enters the leaf and carbon dioxide is given off.

Two leaves are removed from a destarched plant. The upper side of one and the lower side of the other are greased with Vaseline. The stalks of each are dipped in water (1) and the leaves are left in light for four hours so that photosynthesis takes place. Most of the Vaseline is wiped off and the leaves are placed in a solution of iodine in potassium iodide (2). The plant greased on the upper side develops a blue colour (3b), showing that starch has formed by photosynthesis from carbon dioxide, which entered through the leaf pores which are mainly on the underside. No colour develops in the other leaf (3a) in which Vaseline blocked the pores.



When a key is pressed, a system of levers makes a felt-tipped hammer strike a stretched wire. At the same time a *damper*, which normally prevents the wire from vibrating, drops back from the wire and stays back until the key is released. The piano has two pedals. The left-hand pedal helps to soften the notes and the right-hand pedal holds the notes longer.

Picasso, Pablo (1881-1973) was one of the most significant painters of the 1900's. His originality is unparalleled, and it can be said that he changed the whole nature of painting. He took this great art out of the merely imitative stage. He advanced painting into a realm of expression of profound and often disturbing ideas by the creation of images which expressed thought as well as the depiction of forms and objects.

Picasso was born at Malaga in Spain, the son of a local painter and art teacher. After studying at art schools in Barcelona and Madrid in Spain he moved, in 1903, to Paris, and spent most of his life in France.

At first he painted realistic pictures with ordinary people as his subjects. Life in circuses and big cities fascinated him. But even his early paintings were aimed to show the misery of poor people as well as showing their actual appearance. He painted a great number of studies in various shades of blue to convey the sadness and pathos of circus performers' lives. This part of Picasso's life is known as his *blue period*. In 1905 his painting became less sombre and he entered his *pink period*.

Gradually he began to paint in a most revolutionary style called *cubism*. In cubism, the picture is built up of triangles and cubes. It shows several dimensions and aspects of the subject at one and the same time. *Ambroise Vollard* is a significant cubist portrait by Picasso of this period, showing an art dealer.

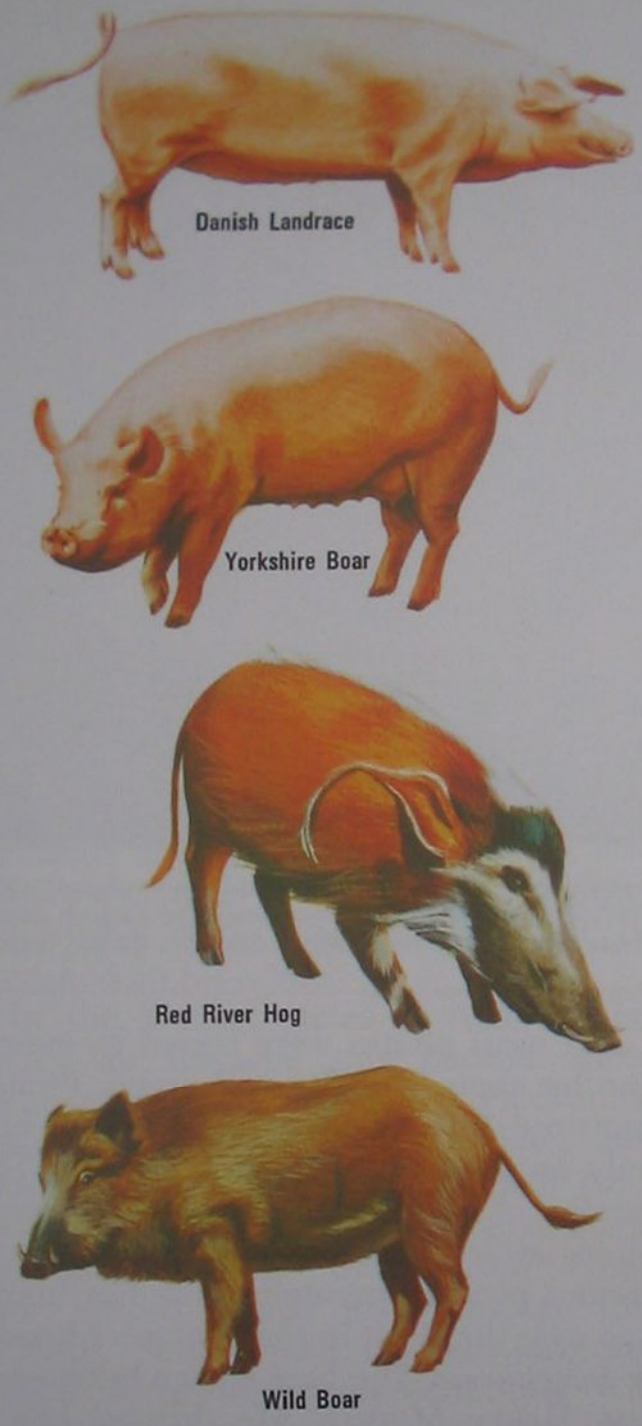
From 1918 to 1924 Picasso's painting was more natural. But he gradually began to use colours and shapes to show intensity of feeling. His painting called *Guernica* expresses in agonizing images the artist's horror at the bombing of a defenceless town during the Spanish Civil War, which broke out in 1936.

Picasso was a superb draughtsman. And he brought his talents to the creation of images that express in an unconventional way such themes as grief and agony. His art ranges over many mediums such as etching, lithography, book illustration and designs for ballet sets. His pottery and sculpture are unique. He often took familiar objects, such as the handlebars and saddle of a bicycle, and formed them into new images simply by careful and patient rearrangement.

Pablo Picasso's *The Three Dancers* was painted in 1925. It is characteristic of the artist's abstract style.

Pigs are important farm animals. They provide us with meat in the form of ham, bacon and pork, while leather can be made from their skins. The fat is made into lard.

Kinds of Pigs



A male pig is called a *boar* and a female a *sow*. In the United States, pigs are called *hogs*.

The world's leading pig-farming countries are Russia, the United States, China and Brazil. Pigs are useful animals to keep on small farms because they take up little room. They are normally fed on 'coarse' grains, such as maize, and various farm byproducts. The Landrace pig, for instance, which has been bred in Denmark to produce high quality bacon cheaply, thrives on a diet of barley and skimmed milk left over from butter-making.

Pigs are large, stout animals, sometimes weighing as much as 1,000 pounds, although today pigs rarely weigh more than 600 pounds.

Wild pigs are found in warm regions of the world, including the wart hog of Africa and the wild boar of Africa, Asia and Europe. They generally have poor eyesight, but make up for this defect by a keen sense of smell.

Pilgrim Fathers At the beginning of the seventeenth century, a small group of extreme Puritans, very religious people, lived in Nottinghamshire. Fearing punishment for holding their own meetings and not going to the parish church, they decided to go to Holland. After setbacks, they finally succeeded. Several years later, led by William Brewster, some of them decided to settle in North America. They crossed to England and, joined by other men and women, sailed from Plymouth in the *Mayflower* in September 1620. After a long and stormy voyage, of two months, the *Mayflower* arrived safely at Cape Cod.

In December 1620 a site for building houses was found and named New Plymouth. Land was cleared and the following autumn, with their first harvest safely gathered in, the Pilgrims held a feast, the first *Thanksgiving*.

Before landing, the Pilgrims agreed to set up their own government. They became the first *freemen* of the colony, who met each year to make laws and elect the governor. The first governor was John Carver and the next was William Bradford.

Piranha is a ferocious, tropical, freshwater fish. Some experts believe it to be more dangerous than a shark. There are several *species* (kinds), found mainly in the Amazon and Orinoco rivers and their

A painting by William Van De Velde The Younger (1633-1707) shows Barbary pirates attacking an English ship. These pirates from North Africa operated for 300 years.

tributaries, in northern South America. The piranha is a bony, deep-bodied fish that grows up to about 12 inches long. Piranhas swim in huge shoals and have a keen sense of smell. If they detect blood on any animal, however large, they will attack. Their jaws bristle with needle-like teeth, and they will strip their prey to a skeleton within a few minutes.

Pirates are robbers who commit their crimes at sea. Piracy is very rare nowadays, but between the 1500's and 1700's many men became pirates. Most were desperate criminals, but some, known as *privateers*, were authorized to attack enemy ships in time of war and to keep much of the loot. Francis Drake was a privateer, and indeed a pirate, because he plundered Spanish ships in peace time and without Queen Elizabeth's authorization. The English regarded Drake as a patriot. Similarly, the Americans forgave Jean Lafitte for his acts of piracy in the early 1800's, because he helped them against the British.

But most pirates were feared by everyone for their brutality and greed. Pirates captured Julius Caesar and released him only on payment of a large ransom. The pirates of the Mediterranean Sea were often called *corsairs*. But the most famous pirates operated in the Caribbean Sea near the West Indies, and were known as *buccaneers*. The best-known buccaneer was Henry Morgan. He dressed like a gentleman and owned a plantation in Jamaica. After a wild career as a privateer, he was made governor of Jamaica and hanged many of his former fellow-pirates.

William Kidd has the reputation of being one of the boldest of pirates, and was hanged as such in 1701. But he had been licensed as a privateer and claimed to the end that he had taken none but French ships, England then being at war with France. Some people believe Kidd was betrayed by his rich sponsors.

Edward Teach was a very different case. Under his nickname of 'Blackbeard' he terrorized the seas round North and South Carolina in the early 1700's. He showed no mercy to the crews of the ships he captured, nor to his own crew. Blackbeard himself crippled his mate Israel Hands with a pistol shot. He was eventually killed in a bloody battle with a British man-of-war.

Two thousand years ago the penalty for piracy was crucifixion. Later pirates were hanged and their bodies were left dangling for months. Now the age of sea piracy is over, and the skull and crossbones, the traditional pirates' flag, is no longer seen.

In the 1960's a new form of piracy known as *air piracy* or *hijacking* became common. Commercial aircraft have been 'held up' while in flight by men (and sometimes, women) who threaten to wreck the plane with bombs or shoot the passengers if they are not paid a ransom or if their political demands are not met. The hijacker also usually demands to be flown to a country where he hopes that he will not be punished for his crime.

In the United States of America, air piracy for financial gain became quite common in the late 1960's. Palestinian guerillas have employed hijacking methods to secure the release of their comrades who are held as prisoners. Some aircraft, especially those from Israel carry armed guards to discourage this practice. Some major airports have installed screening equipment that will detect any passenger who is carrying a gun or a bomb.

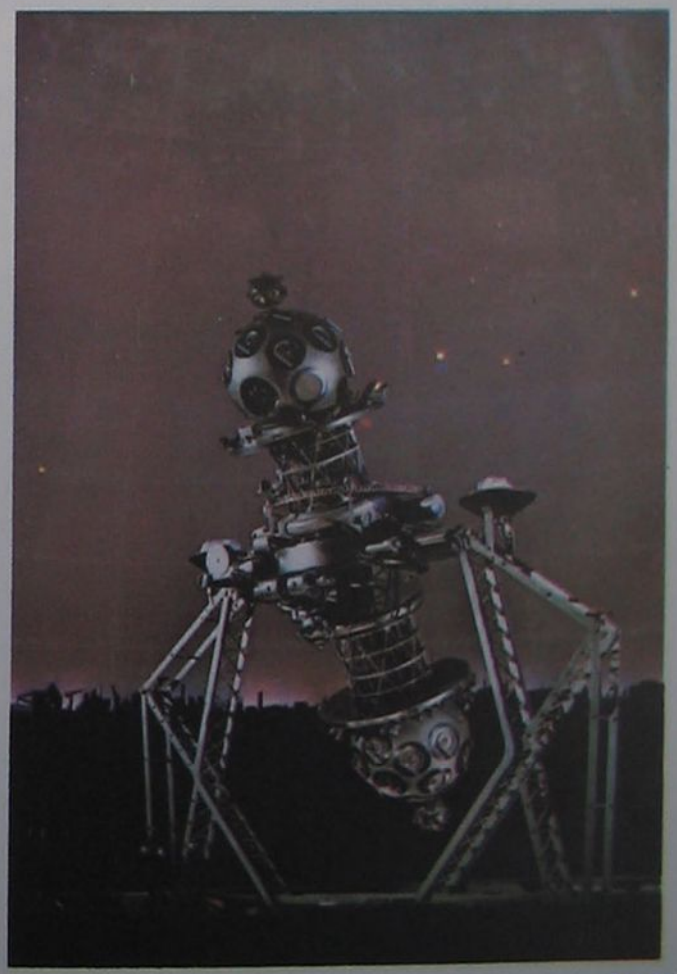
Planet is a heavenly body that revolves around the Sun in an *elliptical* (oval) path. There are nine major planets, including the Earth. They have no light of their own, but shine by reflecting the light from the Sun.

Planetarium is a place for showing the arrangement of the stars, planets and other heavenly bodies, and the paths they follow. Planetariums help people to learn about astronomy—the science of the heavens.

A planetarium consists of a room with a large, dome-shaped ceiling. This ceiling is white or silver like a cinema screen. As the show begins, the lights are turned off leaving the room in darkness. Then dots of light representing the various heavenly bodies are projected on to the ceiling. Each of them is of the correct size and brightness. They move across the ceiling just as the stars and other bodies move in the night sky. A lecturer explains what is being shown. He can regulate the projector to make the movements fast or slow.

The projector is a complex piece of machinery. It really consists of as many as 200 or so tiny projectors. Each of these shows an individual planet or star, a group of stars, or some other part of the sky. The whole apparatus is shaped like a dumbell.

The dumbell-shaped projector of the London Planetarium.



There are planetariums in many large cities. Often they are connected with natural history museums. Generally they have other exhibits about astronomy besides the show of the sky.

Plankton is the great mass of floating and drifting animals and plants found in the sea and in ponds. Most of them are so small that they can be seen only with a microscope. They are suspended in the water much like the dust particles we can sometimes see in a beam of light.

The planktonic plants are extremely important to the life of the sea, because they are responsible for making nearly all the food material in the sea. They do this by the process called *photosynthesis* (see Photosynthesis). The tiny animals of the plankton graze on the plants. They in turn are preyed on by larger animals (such as herring) which are in their turn eaten by larger fish (such as cod). In fact, some of the sea's largest creatures—some whales and sharks—eat only plankton.

Planktonic plants live only in the upper levels of the water because they must have sunlight to carry on photosynthesis. Not enough light penetrates below about 150 feet in most parts of the sea for photosynthesis. Planktonic animals may, however, swim down several hundred feet during daylight, but then float to the surface again at night.

The plants of the plankton are called *phytoplankton*; the animals, *zooplankton*. All phytoplankton come from the large group of plants called *algae*. The main type are *diatoms*, which range in size from 1/2,500 to 1/250 of an inch. They are single-celled, and each consists of an irregular sac of protoplasm (living jelly) surrounded by a delicate, transparent box or shell. Diatoms occur in a great variety of beautiful shapes, often with fine spines.

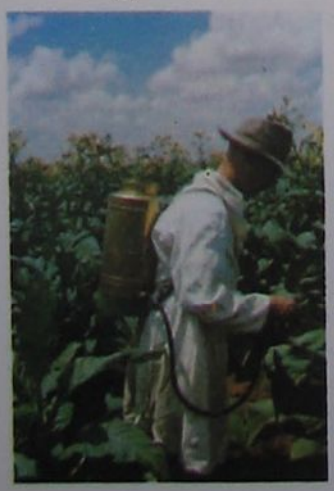
The zooplankton consist of members of many animal groups, including protozoans (single-celled animals), jellyfish, worms and snails. But the largest group are crustaceans, particularly the type known as *copepods*, or oar-footed creatures. These all spend their entire life as plankton. Other sea animals, such as fish, crabs, barnacles, starfish and many molluscs, are planktonic only as eggs or when young. They then settle on the sea-bed, or become free-swimming members of the *nekton* (the active swimming group).

The picture shows some of the many tiny plants and animals that live in the sea. The plankton here includes dinoflagellates (top and bottom left), diatom (top right) and a strange sea snail (bottom centre).

Brown spots caused by blight on a corn cob. Much valuable food is destroyed by plant diseases, and sometimes they cause famines.

Plant diseases cause great damage to crops every year. They may kill whole fields of cereal crops or root crops, or whole orchards of fruit trees. Some diseases affect the crops so that they are of low quality and poor yield. Plant diseases can cause famine by destroying important crops. In Ireland, an epidemic of fungus blight destroyed the potato crop in 1845 and for several years afterwards there was widespread famine. Three-quarters of a million people starved to death.

Fungi attack many kinds of plants.



Chemical sprays are used throughout the world to protect plants against diseases. Constant care has helped to raise crop production. Insecticides and weedkillers destroy insects and weeds that harbour and spread disease.

Rusts and *smuts* are fungal diseases affecting cereals. Rye infected by a fungus called *ergot* may cause serious illness in anyone eating bread made from it. But ergot is also a source of useful drugs for controlling blood pressure. Bacteria and viruses attack plants as well as men and animals. Viruses produce *mosaic disease,* which affects fruit trees, tobacco, and other crops.

Plant diseases can be controlled by breeding new strains of plants resistant to disease. Rotation of crops helps to reduce the occurrence of disease, and chemicals can be added to the soil to prevent disease breaking out.

Plants make up one of the two major divisions or *kingdoms* of living things. A plant is an organism that lives and grows in one place, is typically green, makes its own food, and normally has stems, leaves

and roots. Some simple plants, such as seaweed, may not show all of these features, but, apart from fungi and a few strange parasites, they all make their own food.

Plants are the most successful organisms on earth. They are entirely self-sufficient and in this way are far superior to animals, which have to eat plants (or other animals that eat plants) to survive. Most plants make their own food. The green colour that characterizes the plant world is caused by *chlorophyll*. This is a complex but vital substance which helps the basic reactions of *photosynthesis*, the process by which the Sun's energy is used to make food (see Photosynthesis). The end-products of photosynthesis are sugars and starch. But these compounds are energy banks for building all the proteins, fats and vitamins plants need.

Plants make all the foods they need from raw materials they gather from the soil and from the air, which are all around them. This fact alone accounts for many of the big differences between plants and animals. Plants have no organs for moving about, and no sense organs (although they do react to the stimulus of light, gravity, and so on). They are in no way streamlined as many animals are. In fact, their way of life tends to make them quite the opposite. Branches and roots grow out in all directions to gather carbon dioxide for photosynthesis above the ground, and water and mineral salts from the soil below the ground.

There are few places in the world where some kind of plant cannot survive. In the freezing *tundra*, lichens survive and form the staple diet for wandering herds of reindeer. Far out to sea, tiny plants grow provided that there is just a glimmer of light for their photosynthetic pigments to work. Some freshwater algae flourish in hot springs at 60° C or more.

Scientists have listed about 350,000 kinds of plants. Of these, some 250,000 belong to the highly successful flowering plant group, whose members are easy to see wherever you are. A brief look at some other members will give some idea of the variety of this kingdom.

Algae are primitive plants whose typical home is the water. Salt-water algae are called seaweeds. Algae contain chlorophyll (and often other pigments), and make their own food. Since they live in water they have no roots. (See Algae.)

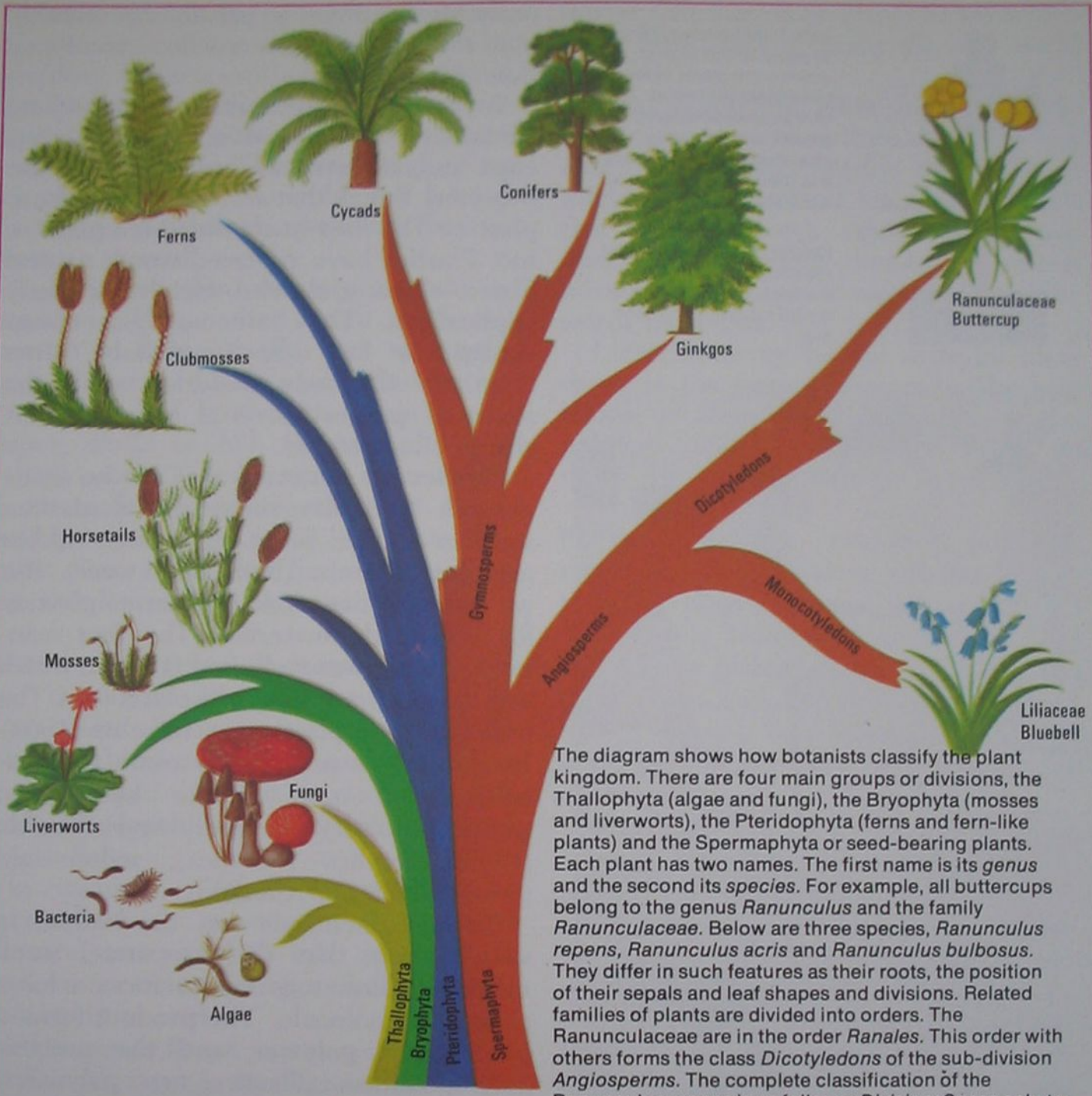
Mosses and liverworts live on land. They have no proper roots and cannot live for long without moisture. These small plants are often restricted to the banks of streams and the floors of forests and woods. Mosses have upright leafy stems which bear a long stalk with a swollen spore capsule at the tip. Some liverworts are leafy, but others live close to the ground in flat, tongue-like growths. Liverwort spore capsules are a lot simpler than those of mosses, and this is the chief distinguishing feature. (See Mosses.)

Ferns, together with club-mosses and horsetails, represent a considerable advance on mosses and liverworts, because they possess distinct stems, leaves and roots. They also have strands of conducting tissue which convey food and water around the plants. Yet most ferns are still restricted to damp habitats, because part of their life is spent as a separate plant called a *prothallus*, which would soon shrivel and die in dry places. (See Fern.)

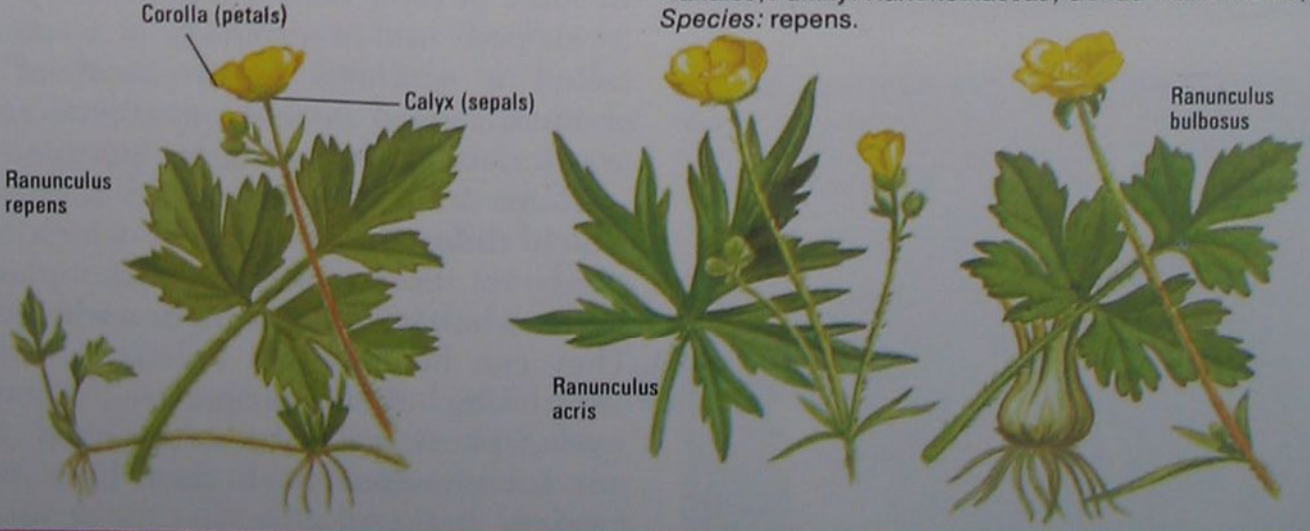
Cone-bearing trees—pines, firs and cycads—have taken the solution of the water problem a step further. They do not release their spores to form a separate plant: the spores develop right on the plant. Male cells then fertilize the female cells, which develop into seeds. Mature seeds are finally released to form new cone-bearing plants. (See Conifers.)

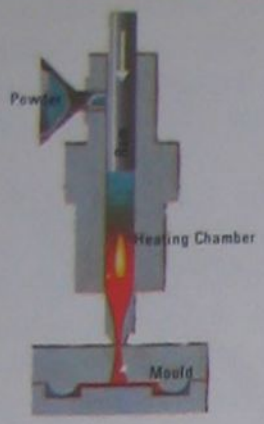
Flowering plants produce flowers, not cones, and wrap their seeds in protective layers. (See Flowering plants; Flowers.)

Plastics What is light, flexible, tough, resists water and chemicals and can be drawn out into a transparent sheet or moulded into complicated shapes? Obvi-



The diagram shows how botanists classify the plant kingdom. There are four main groups or divisions, the Thallophyta (algae and fungi), the Bryophyta (mosses and liverworts), the Pteridophyta (ferns and fern-like plants) and the Spermaphyta or seed-bearing plants. Each plant has two names. The first name is its *genus* and the second its *species*. For example, all buttercups belong to the genus *Ranunculus* and the family *Ranunculaceae*. Below are three species, *Ranunculus repens*, *Ranunculus acris* and *Ranunculus bulbosus*. They differ in such features as their roots, the position of their sepals and leaf shapes and divisions. Related families of plants are divided into orders. The Ranunculaceae are in the order *Ranales*. This order with others forms the class *Dicotyledons* of the sub-division *Angiosperms*. The complete classification of the Ranunculus repens is as follows: *Division:* Spermaphyta; *Sub-division:* Angiosperms; *Class:* Dicotyledons; *Order:* Ranales; *Family:* Ranunculaceae; *Genus:* Ranunculus; *Species:* repens.





Left: Injection moulding press in which plastic articles are made from thermoplastic resins. A ram pushes powdered plastic into a heating chamber where it softens. It is then forced into a mould.

Below: Some of the many plastic products.
Bottom: The extrusion of layflat tubular polythene film.

ously, it must be a plastic. No natural material has such a marvellous combination of properties.

Toys, clothes, pipes, fittings, car bodies, containers, bottles, tiles, gears, plates, cups and saucers are just a few of the everyday things that are being made from plastics. The man-made fibres are plastics, too. Plastics have replaced wood, natural fibres, china, glass and metals for many applications. They are not just cheap substitutes for other materials; often they are the only materials with the required properties. And they are not always cheap either.

Plastics are materials that can be easily shaped. There are some natural plastics, such as shellac (from an insect), rubber and gutta percha (both from trees). But we normally reserve the term 'plastics' for man-made materials. The first man-made plastic was Celluloid (1860's), which was made from the cellulose in cotton. The first synthetic plastic was Bakelite (1909). In the 1930's and 1940's came the discoveries of most of our best-known plastics—polystyrene, polyvinyl chloride (PVC), acrylics (Perspex), nylon and polyethylene (Polythene).

Certain chemicals can be treated in such a way that their separate, small molecules link together to form a long, chain-like molecule. The product formed is called a *polymer*, and the process *polymerization*. Plastics are polymers, which explains the presence of 'poly' in some of their names. Before the plastic is shaped into a product, it is usually called a *synthetic resin*. Most of the chemicals used to make synthetic resins are derived from coal tar or petroleum.

There are two main groups of plastics, which differ in the way in which they react to heat. *Thermoplastic* plastics soften when heated and harden when cool. They can be remelted indefinitely without losing their properties. *Thermosetting* plastics, on the other hand, cannot be remelted once they have been formed.

Plastic articles can be made in a variety of ways. One of the most common is by *moulding*. Molten synthetic resin is forced into a mould and allowed to cool. Thermoplastic resins are either *injected* or *blown* into the mould. Thermosetting resins are *pressed* into the mould and heated. *Casting* is similar to moulding, but no pressure is used.

Tubing and thin sheets are made by *extrusion*. The molten resin is forced through a hole, or *die*, just as toothpaste is squeezed from a tube. *Laminating* is a method of sandwiching thin sheets (paper, cloth, or foil, for example) into a thick panel. The sheets are coated with plastic and pressed together. In *calendering*, rollers squeeze molten resin into a thin film. It is used for making sheet and also for coating cloth and paper.

Platinum is a precious metal more valuable than gold. It is similar to gold in many ways. It does not lose its colour (silvery white) and shine, and it can be easily shaped. But it is heavier and harder than gold. One of its main uses is in jewellery.

In industry, platinum is valuable as a *catalyst*—a substance that helps chemical processes to take place. It is used as a catalyst in oil refining and in making nitric acid.

Platinum is found in the pure state in the Earth's crust as small grains in certain gravels. It is expensive to extract.

Plato was a Greek philosopher who lived four hundred years before the birth of Christ. At the age of twenty-one, he became a pupil of the philosopher, Socrates. Made bitter by Socrates' death, he left Athens to travel and study elsewhere. But eventually he returned and founded the Academy, the first university in the world.

Plato believed that beyond the real world, which man experiences with his senses, there is an ideal world, which man can experience only with his mind. He believed that man must strive to know this ideal world and to bring the real world closer to it.

Plato would not allow his lectures at the Academy to be written down. He was afraid that readers outside the Academy might not understand his ideas. He felt that written words could not answer questions or defend themselves against misunderstanding as a man can defend the words he speaks.

Later, however, he did write his ideas down in the form of *dialogues*. The best known of these is *The Republic*. It is a political dialogue, in which Plato set down the requirements for an ideal state.

Platypus This is an extremely primitive mammal that lives along streams in Australia. It does not bear live young, but lays small, leathery-skinned eggs. Yet the mother platypus does feed her young on her own milk, and the animals do have hair. They are, therefore, true mammals, although only distantly related to the rest of the group.

The platypus grows about two feet long, including a thick tail. It has a bill like that of a duck, and as a result is sometimes called the duck-billed platypus. The bill is skin-covered, while the rest of the body is covered in velvety fur. Platypuses have clawed and webbed feet, and are good swimmers. They eat worms, snails, and other small water creatures. Platypuses grow to a length of about 2 feet, with 6-inch-long tails.

The platypus is a primitive mammal of Australia. It lays eggs and does not bear live young, unlike other mammals, but it does suckle its young, a feature that distinguishes mammals from other animals.

Pluto was discovered by the American astronomer Clyde Tombaugh in January, 1930. These photographs were taken three days apart and show the planet moving in relation to the stars.

Pluto is the outermost of the planets in our Solar System. Even through the most powerful telescopes, Pluto appears only as a tiny yellowish spot.

Pluto's discovery was a triumph of modern astronomy. In 1905, the American astronomer Percival Lowell became convinced that another planet existed. He showed that irregularities in the movements of Uranus and Neptune must be caused by this unknown planet, but he died before finding it.

In 1930, another astronomer, Clyde Tombaugh, photographed part of the night sky while continuing Lowell's search. He compared photographs taken on different nights, and noticed that one point of light on them had changed position. The point of light was Lowell's unknown planet, which astronomers now call Pluto. The planet appeared near where Lowell's calculations predicted it would be.

The average distance of Pluto from the Sun is 3,667 million miles. Its diameter is believed to be about 3,700 miles.

Poetry It is sometimes difficult to distinguish poetry from prose. Most poetry has been written in *metre*, a pattern of fixed rhythms called *feet*, and has made special use of rhyme. But poetry does not always have strict rhyme and rhythm to help us to recognize it easily, and there is some prose that, when read aloud, comes very near to being poetry. A poet chooses words for their sound as well as their meaning, and he appeals to the reader's imagination. And in poetry the words are more closely packed with meaning than in prose.

The techniques of writing poetry have varied from age to age and from country to country. In Ancient Greek and Latin poetry, metre was determined by the length of the syllables in a line. French poetry is measured according to the number of syllables. English and German metre is governed by stress.

There are various traditional patterns of rhythm and rhyme. A *couplet* is a pair of rhyming lines of equal length. A *quatrain* is a four-line *stanza* (group of lines), most commonly with alternately rhyming lines. Many poets have needed a less

A sonnet is a poem of 14 lines grouped in 8 and 6:

Earth has not anything to show more fair:
Dull would he be of soul who could pass by
A sight so touching in its majesty:
This city now doth, like a garment, wear
The beauty of the morning: silent, bare,
Ships, towers, domes, theatres, and temples lie
Open unto the fields, and to the sky;
All bright and glittering in the smokeless air.
Never did sun more beautifully steep
In his first splendour, valley, rock, or hill;
Ne'er saw I, never felt, a calm so deep!
The river glideth at his own sweet will:
Dear God! The very houses seem asleep;
And all that mighty heart is lying still!

Composed upon Westminster Bridge William Wordsworth

Ballads have simple, four-line verses:

She hadna sail'd a league, a league,
A league but barely three,
Till grim, grim grew his countenance
And gurly grew the sea.

Old Ballad

Many poets have written in rhyming couplets:

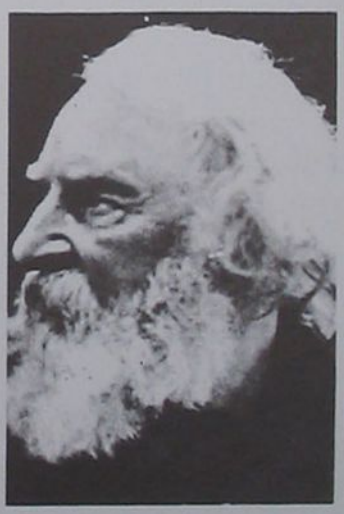
A little learning is a dang'rous thing;
Drink deep, or taste not the Pierian spring;
There shallow draughts intoxicate the brain,
And drinking largely sobers us again.

An Essay on Criticism Alexander Pope

The following are some of the most important poets with examples of their work:

Homer (Greek, 9th century B.C.?) – *The Iliad*
Virgil (Roman, 70-19 B.C.) – *The Aeneid*
Horace (Roman, 65-8 B.C.) – *Odes*
Dante Alighieri (Italian, 1265-1321) – *Divina Commedia*
Petrarch (Italian, 1304-74) – *Canzionere*
Geoffrey Chaucer (English, 1340-1400) – *Canterbury Tales*
François Villon (French, 1431-?) – *Petit Testament*
Luis de Camoens (Portuguese, 1524-80) – *The Lusiads*
Pierre de Ronsard (French, 1524-85) – *Sonnets to Helen*
Edmund Spenser (English, 1552?-99) – *The Faerie Queene*
William Shakespeare (English, 1564-1616) – *Sonnets*
John Donne (English, 1571-1631) – *Collected Poems*
Robert Herrick (English, 1591-1674) – *Hesperides*
George Herbert (English, 1593-1633) – *The Temple*
John Milton (English, 1608-74) – *Paradise Lost*
Jean de la Fontaine (French, 1621-95) – *Fables*
John Dryden (English, 1631-1700) – *Absalom and Achitophel*
Alexander Pope (English, 1688-1744) – *Rape of the Lock*
Thomas Gray (English, 1716-71) – *Elegy in a Country Churchyard*
Oliver Goldsmith (English, 1728-74) – *The Deserted Village*
Johann von Goethe (German, 1749-1832) – *Faust*
William Blake (English, 1757-1827) – *Songs of Innocence*
Robert Burns (Scottish, 1759-96) – *The Jolly Beggars*
Friedrich von Schiller (German, 1759-1805) – *Die Glocke*
William Wordsworth (English, 1770-1850) – *Lyrical Ballads*
Samuel Taylor Coleridge (English, 1772-1834) – *The Ancient Mariner*
George Gordon, Lord Byron (English, 1788-1824) – *Childe Harold*
Percy Bysshe Shelley (English, 1792-1822) – *To A Skylark*
John Keats (English, 1795-1821) – *Endymion*
Heinrich Heine (German, 1797-1856) – *Buch der Lieder*
Giacomo Leopardi (Italian, 1798-1837) – *To Italy*
Alexander Pushkin (Russian, 1799-1837) – *Eugene Onegin*
Victor Hugo (French, 1802-85) – *La Légende des Siècles*
H. W. Longfellow (American, 1807-82) – *The Song of Hiawatha*
Alfred Tennyson (English, 1809-92) – *Morte d'Arthur*
Robert Browning (English, 1812-89) – *Dramatis Personae*
Walt Whitman (American, 1819-92) – *Leaves of Grass*
Charles Baudelaire (French, 1821-67) – *Fleurs du Mal*
Matthew Arnold (English, 1822-88) – *Poems, 1853*
Christina Rossetti (English, 1830-94) – *Goblin Market*
Thomas Hardy (English, 1840-1928) – *Wessex Poems*
Gerard Manley Hopkins (English, 1844-89) – *Collected Poems, 1918*
Robert Louis Stevenson (Scottish, 1850-94) – *A Child's Garden of Verses*
A. E. Housman (English, 1859-1936) – *A Shropshire Lad*
W. B. Yeats (Irish, 1865-1939) – *Poems, 1895*
Robert Frost (American, 1874-1963) – *Collected Poems, 1930*
John Masefield (English, 1878-1967) – *Ballads and Poems, 1910*
Guillaume Apollinaire (French, 1880-1918) – *Rain*
Ezra Pound (American, 1885-1972) – *Cantos.*
Rupert Brooke (English, 1887-1915) *Collected Poems, 1918*
T. S. Eliot (American, 1888-1965) – *The Waste Land*
Wilfrid Owen (English, 1893-1918) – *Strange Meeting*
W. H. Auden (English, 1907-1973) – *Look, Stranger!*
Dylan Thomas (Welsh, 1914-53) – *Collected Poems, 1934-52*
Robert Lowell (American, 1917-) – *Lord Weary's Castle*

Above: A bust of Homer.
Above right: A photograph of Alexander Pushkin.
Right: A portrait of William Wordsworth.
Below: A photograph of H.W. Longfellow.
Below right: A portrait of Percy Bysshe Shelley.
Bottom left: A portrait of John Keats.
Bottom right: A portrait of George Gordon, Lord Byron.



rigid framework. *Blank verse* is metrical but does not rhyme, while *free verse* is not restricted by rhyme or metre.

The poet expresses his personal emotions in *lyric* poetry, one form being the *sonnet*. He tells stories in *narrative* poetry, in *ballads*, which were originally sung, or in *epics*, dealing with heroic people and events.

Poison is any substance that causes death or illness when absorbed by the body. Poisons work harm in various ways. Some cause the muscles of the heart to contract so strongly that they 'seize up' after a time, and the heart stops entirely. Others affect the blood pressure or the nerves.

There are many substances that may be safely applied to the outside of the body, but are dangerous if swallowed. For this reason, one must be careful to follow a doctor's directions when taking medicines. It is also very important to be sure not to eat or drink anything unfamiliar—especially anything growing wild, like berries or mushrooms—without first checking to find out whether it might be poisonous.

Poisons have been put to many different uses. They are commonly used for controlling pests and as weapons of war. Poisoned arrows have given way to poison gases, but the destructive aim remains.

A more positive use of poisons is in medicine, where they may save life if given in the correct doses.

Poisonous plants are harmful to people and animals. Some are dangerous to touch. They can cause rashes and severe itching. An example of this kind of plant is the poison ivy common in Canada and the United States. Many others are dangerous to eat. They cause serious illnesses or even death.

A number of poisonous plants belong to the nightshade family. One of the most common of these is called deadly nightshade. Another name for it is *belladonna*. The tobacco plant, another member of the family, contains the poison nicotine. Henbane and thorn apple, both poisonous, belong to this family too.

The black berries of deadly nightshade are poisonous.

The buttercup family contains several dangerous plants. They include monkshood, larkspur and hellebore.

Poisonous plants are sometimes hard to identify. Many of them resemble plants that are harmless. For example, some mushrooms are perfectly safe to eat and are valued as food. Others, that look very similar, can cause death if they are eaten. It is safest never to eat wild mushrooms of any kind.

Some poisonous plants are deceptive because of their attractive appearance. Children may be tempted to eat poisonous berries because they are pretty. Even a few edible fruits and vegetables have poisonous parts. The pink stalks of the rhubarb plant are safe and delicious to eat. But the green leaves contain highly poisonous salts of oxalic acid.

A number of drugs that are valuable in medicine are made from poisonous plants. Among these are belladonna, quinine, atropine, morphine and digitalis.

Poland is a country in central Europe. Bordered by the Baltic Sea, Russia, Czechoslovakia and Germany, Poland has been invaded and fought over many times. It has a communist government and is closely allied with Russia.

Opposite: The yellow flowers of the Laburnum are followed by pods containing tiny green 'peas'. These are very poisonous and young children should be warned of them.

Poland is almost entirely flat. Many lakes and forests lie in the north. In southern Poland, the thickly forested Carpathian mountains form the border with Czechoslovakia. Poland has warm summers and cold winters.

Nearly half of Poland's people are farmers. Many of them work on state-owned farms where cereals and vegetables are the major crops. The forests provide timber, wood pulp and paper which are important exports. Poland is a leading producer of coal. Industry is expanding and is mostly government controlled.

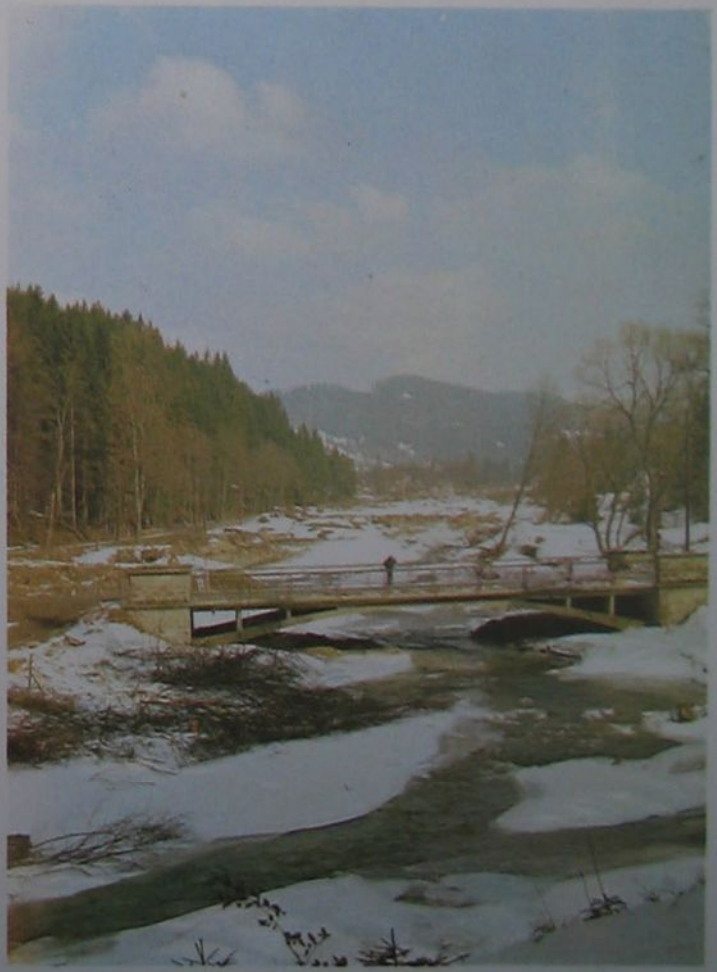
In the A.D. 900's, tribal people united into a nation with borders similar to the Poland of today. From the late 1300's to the 1600's, Poland enjoyed its greatest prosperity. Poland was invaded in 1772, 1793 and 1795 and divided between Austria, Prussia and Russia. After many revolts, Poland became an independent state in 1918. In the early 1920's, under Józef Pilsudski, Poland extended its eastern borders by taking territory from Russia.

In 1939, Poland was invaded by Germany and Russia who partitioned the country between them. In 1941-1945, Germany controlled Poland and large numbers of people were deported and killed. In 1945, the Russians army drove the Germans out and a Polish communist government was set up. From 1956, following a revolt, reforms were introduced, and more religious freedom was granted. In 1968, with Russia, Poland moved troops into Czechoslovakia to keep that country communist.

Facts and Figures
Area: 120, 359 square miles.
Population: 33,000,000.
Capital: Warsaw.

Polarized light is light whose waves vibrate in one direction only – for example, up and down or from side to side. Ordinarily, light waves vibrate in many directions. Light becomes polarized when it is reflected from a surface.

Left: Location map of Poland.
Below: The Lenin steel foundry at Krakow, Poland. Polish industry, which also includes shipbuilding and chemicals, is mostly state-controlled.
Right: The River Vistula rises near the border of Poland and Czechoslovakia, and flows through Krakow and Warsaw.



Policemen have many duties to perform. The New Zealand policeman (above) notes details given to him by a motorist. At Scotland Yard in London, policemen record the latest information about traffic jams and crimes on large-scale maps (above right). River police use boats on the River Thames in London (right).

Or it can be polarized by passing it through a polarizing filter, which cuts out all the wave vibrations except those in a certain direction. If a second such filter is held in front of the first and turned a quarter circle, it will cut out all the remaining wave vibrations and block the light completely. Polarizing filters include certain crystals, such as tourmaline and Iceland spar. But most filters are made of a plastic material.

Polarizing filters are used in sunglasses, car windscreens and photographic lenses to cut down glare and reflection. A pair of such filters in an instrument known as a polariscope enables scientists to detect flaws in transparent materials and stress areas in transparent models of structures, and to measure the strength of sugar solutions. Polarizing filters are also used in three-dimensional photography.

Police are responsible for keeping law and order, preventing crime, and detecting criminals. In a democratic country they guarantee every citizen the right to live without fear for his life or his property.

The main task of a policeman is to prevent crime. In every town, uniformed policemen patrol the streets either on foot or in a vehicle, ready to deal with any emergency. They have special powers which allow them to search or arrest people. The uniformed police also control traffic.

The other main job of policemen is to detect crimes and catch criminals. This is the most spectacular, and sometimes dangerous, part of police work, although it often involves long and tedious routine work. Detectives have many scientific aids.

Forensic experts test objects and clothing for bloodstains and other clues. Fingerprint experts make their reports. Experts in firearms, photography, and other crafts and sciences are also available. The descriptions of wanted men can be circulated to police forces all over the country and—through Interpol, which is the international police organization—throughout the world.

Special branches of the police guard against crimes committed from a political motive. They keep watch on those suspected of dangerous political activities, particularly if they are from another country.

Many countries have national police forces under one central controlling body. Other countries have both a national and smaller and local forces. In the United States the Federal Bureau of Investigation (FBI) and other national agencies help the city forces only in certain circumstances. Britain and other countries have only local forces. The largest in Britain is London's Metropolitan police force. Scotland Yard is its CID. This force was the first professional police force in Great Britain. It was formed in 1829 by Sir Robert Peel.

Political parties Politicians group themselves together in order to win support from the electorate. (See Elections.) Such groups are called *parties*. A party adopts a common programme to put before the voters, which it promises to carry out if it wins a majority in parliament in the election.

In Britain and the United States there are two big parties. Until this century Britain was ruled by either the Conservative or the Liberal Party. Then the Labour Party became more popular than the Liberals and has been in government several times.

In the United States the two parties are the Democrats and the Republicans. Many countries have more than two parties. In most of Europe there are Christian-Democratic and Socialist parties. In France, Finland and Italy there are strong Communist parties as well (see Communism); in other countries various Liberal parties. Since 1945, parties in Europe have become fewer, so that a kind of two-party system is growing up. Where no single party has a majority, several combine into a *coalition*, to form the government. (See Government; Parliament.)

Parties may bring together people of the same social class. The Labour Party in Britain has more support from the workers than from other classes. Christian-Democratic parties unite people who believe that there is a definite Christian policy. In Arabia, Africa and Asia there are Muslim, or Mohammedan, parties.

Other parties get their support from particular geographical areas. The Democratic Party in the U.S.A. had overwhelming support from the southern states for many years. Bavaria, in western Germany, has its own party, the Christian Social Union.

In countries which have become Communist, the Communist party is either the only party or it dominates a coalition of other parties. In many Asian and African countries this one-party form of government now exists, with a nationalist party in power. There is no legal Opposition and voters cannot change the government at an election. This makes it easier for a country to raise itself from backwardness and poverty quickly; but it can lead to tyranny. People are afraid and the government ceases to know what the people really feel.

Pollination All flowering plants must be *pollinated* before they can produce seeds. Pollination is the transfer of pollen from the stamens to the stigma of flowering plants. The stigma is an area of the female part of a flower. It is attached directly, or indirectly, through a stalk called the *style*, to the carpel, which houses the ovules and female egg cells.

A stamen consists of a stalk called a *filament* bearing two bags called *anthers*. The bags are packed with yellow pollen grains. Ripe anthers split open, exposing the pollen. If a pollen grain from a suitable individual falls on the stigma, the grain thrusts a thread-like tube through the receptive surface thereby gaining access to the carpel and fertilizing the flower.

Flowering plants typically have stamens and carpels in the same flower. However, seeds that develop from ovules fertilized by pollen from the same flower are not so healthy (on average) as those that develop from ovules fertilized by pollen from a different individual of the same species. So it benefits a plant species to ensure that its stigmas receive pollen from different flowers.

In many kinds of plants the stamens ripen first and then their stigmas, or vice versa. Thus, when the pollen is shed, the stigma is not ripe to receive it. Or, conversely, when the stigmas are receptive, the pollen is not ready.

Flowers use either insects or wind to help in pollination. Those that use insects are often brightly coloured and sweetly scented, and offer a bribe of sugary nectar at the base of their petals. In reaching for the nectar, the insect is dusted with pollen and carries it to the next flower it visits. There, it may brush off some of the pollen onto a ripe and receptive stigma. Flowers that rely on the wind are rather drab. They produce lots of pollen, because wind pollination is uncertain. A few aquatic plants are pollinated by water.

Before a seed can develop, a pollen cell must join with an egg-cell or ovule inside the carpel of a flower. Pollination, the transfer of pollen, is often carried out by insects. Left: Orchids have pollen lumps that stick to visiting insects. Below: Bees' legs have hairs that trap pollen.

Insect-pollinated flowers are usually brightly coloured to attract insects. Below left: The nectar of scabious also attracts insects, which will carry away pollen after feeding. Right: Wind-pollinated plants, such as plantain, release their pollen in the wind to reach other plants.

Pollution is the contamination of the atmosphere, the soil, the rivers and the sea by chemicals produced by modern technology. *Ecologists*, scientists who study the relationships between all living creatures and their environment, believe that pollution is the most important problem facing the modern world. They think that we are in danger of destroying large sections of the plant and animal kingdoms, and also of poisoning the human population with harmful chemicals.

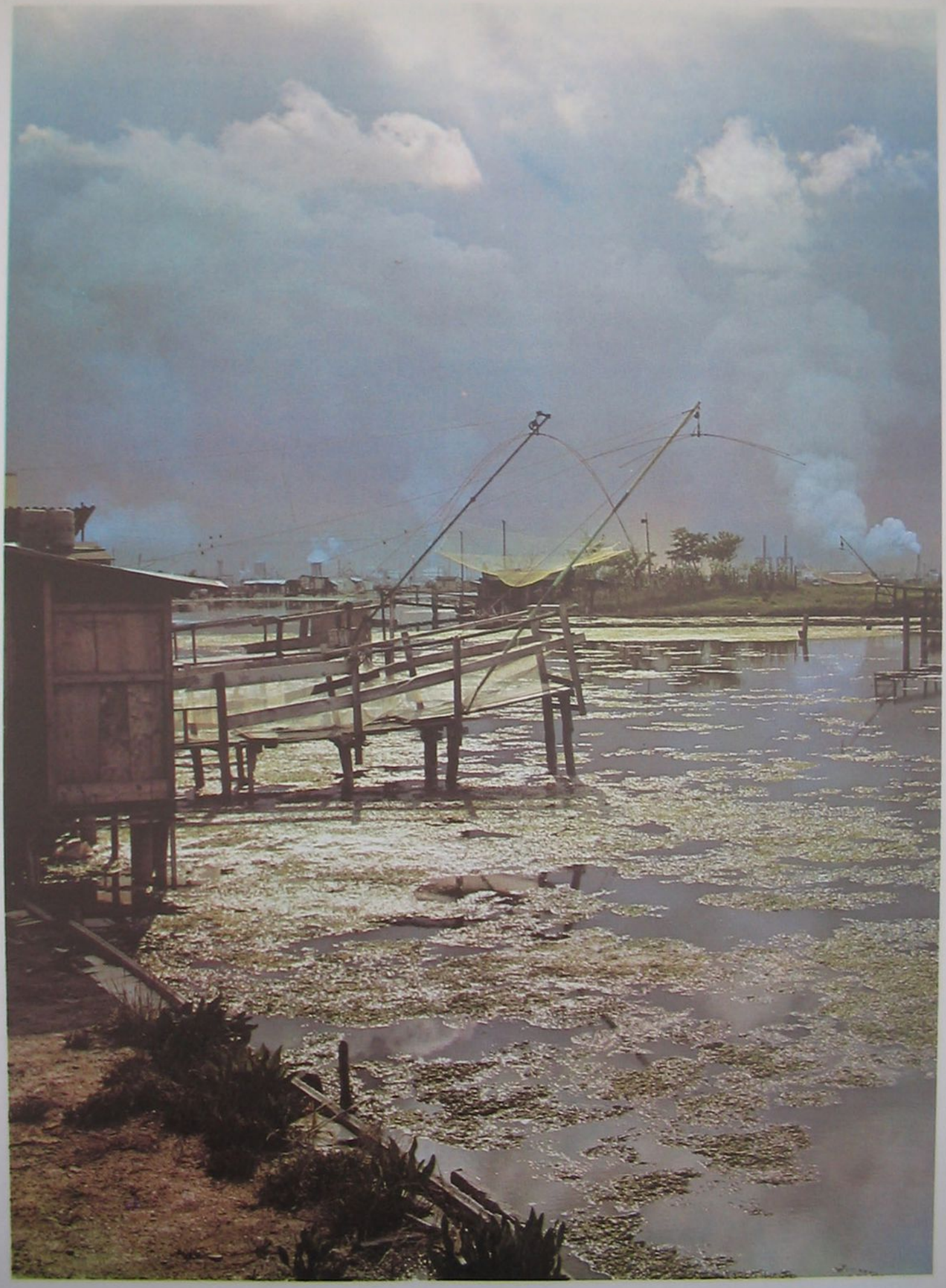
Air pollution is considered the most widespread and harmful form of pollution. It has certainly caused more damage to human beings than either water or earth pollution. Until quite recently, heavy industry was the chief culprit of air pollution. The Industrial Revolution was based on coal and enormous quantities of it

Above: The brown leaves of these trees are due not to autumn but to the poisonous fumes pouring from the factory chimneys. Opposite: Factory pollution kills fish in rivers, and causes scum to cover the surface.

were burned to provide the power to work the mills and factories. The smoke from the furnaces was released into the atmosphere without being treated in any way. As a result, the industrial cities of the world became blackened with soot.

When coal burns, it pollutes the air in two ways. The smoke which coal produces is made up of tiny particles of unburned carbon; it is this that is responsible for the black 'dirt' that settles on buildings. Burning coal also produces sulphur dioxide. This combines with water vapour in the air to form a weak solution of sulphuric acid, which falls as rain. Sulphur dioxide is probably the most harmful of the chemicals that Man has thoughtlessly released into the atmosphere. It corrodes buildings and has caused the ruin of many old churches and other structures. It attacks plants and destroys the inner tissue of leaves and prevents Photosynthesis from taking place. (See Photosynthesis.) Under certain weather conditions it combines with smoke and fog to produce *smog*. When this happens, the sulphur dioxide is unable to be dispersed in the air and becomes far more concentrated. In the London smog of 1952, the concentration of the chemical in the air doubled. About 4,000 people died as a result of this. They were mainly elderly people who were already suffering from bronchitis and other lung diseases.

After this disaster, the British government introduced the 'Clean Air Act'. This restricted the use of coal and other polluting fuels in built-up areas. The act has been very successful and most British cities are now 'cleaner' than they have been for over a century. Similar smogs have occurred in other countries, though with less disastrous results. Many other countries have also made laws to reduce this form of air pollution.



In recent years the automobile has become a serious pollutant of the atmosphere, especially in the United States. The petrol which is used to power cars produces a wide range of chemicals; many of which are highly dangerous. Petrol contains quantities of carbon, as do coal and fuel-oil. In a car engine, combustion is not complete and, as a result, carbon monoxide is ejected into the atmosphere through the exhaust pipe. Lead is added to petrol to make the engine of a car run more smoothly. This also escaped into the air, together with unburned hydrocarbons and nitrogen oxides.

Carbon monoxide is a highly dangerous poison that prevents the blood cells from carrying oxygen to the various parts of our bodies. In industry, the permitted maximum level of carbon monoxide in the air is .00005%. In heavily polluted cities, such as Los Angeles, as much as six times this amount of carbon monoxide have been recorded in the air. The levels of lead, which is also very poisonous, have also reached danger point in some parts of the world, notably Japan. Lead is also produced by aluminium smelting. The hydrocarbons and nitrogen oxides which come from the automobile can combine to produce a smog that irritates the eyes, nose and throat and can cause lung disease.

The United States, which has more and larger cars than any other country, has made laws that demand that cars should emit far less of these harmful substances. In other countries this problem is not so serious, but it cannot be ignored.

Radioactive fallout from atomic bombs is potentially the most dangerous air pollutant of all. In 1963 an international agreement was signed that banned the testing of nuclear weapons in the atmosphere. France and China, however, did not sign this treaty. France has continued to explode atomic bombs in the Pacific Ocean. This has caused a great outcry in New Zealand, where it is thought that radioactive fallout may reach a dangerous level, should these atomic bomb tests continue.

Pesticides, such as DDT, have been a great boon to Man and have helped to increase food production. It is now becoming apparent that they may have serious side effects. Crops that have been sprayed with DDT become impregnated with it. The crops are either consumed by human beings in the form of bread, or are eaten by animals that will eventually be eaten themselves as meat. The human body has no mechanism for disposing of DDT once it gets into the blood stream. The long-term effects of the chemical are not yet known but scientists feel that there is cause for concern.

Both sea and fresh water suffer from pollution. In many countries, rivers and streams are used to carry away chemical *effluent*. In many industrial processes waste chemicals are a by-product. All too often, these harmful substances are poured into rivers and streams and are carried into lakes and into the sea.

Detergents and other chemicals may either destroy fish directly or destroy the vegetation on which the fish feed. Another form of water pollution is the nitrate fertilizers that are put on the land. They can be washed into the rivers by rain. They encourage the growth of poisonous algae which kill other forms of life in the water. Rivers of Europe like the Rhine have become almost devoid of animal life.

Much of the chemical waste released into the rivers eventually flows into the sea. In most cases, the sea is large enough for the effluent to be absorbed. In Japan, however, there have been severe cases of mercury poisoning among fishermen who have eaten tuna fish that have contained large quantities of this substance. The most obvious pollutant of the sea is oil from ships. This kills birds and fishes, and makes holiday beaches unfit to sit on. Even the famous Bondi beach in Australia has now become polluted in this way.

Pollution is a major world problem and in many cases it is a direct result of Man's increased industrial wealth. Gradually, countries are becoming aware of the need to reduce pollution and conserve the environment.

Polynesia Most of the islands in the Pacific Ocean are divided for the sake of convenience into three geographical zones—*Melanesia, Micronesia* and *Polynesia.* Polynesia is the easternmost section and contains some of the more remote islands. The region can be outlined by a vast triangle whose points are Midway in the north, New Zealand in the south-west and Easter Island and Salay-Gomez in the east. Other islands within this area include the Cook, Ellice, Hawaiian, Marquesas, Society, Line and Tonga islands, and Pitcairn and Samoa. The word *Polynesia* means 'many islands'.

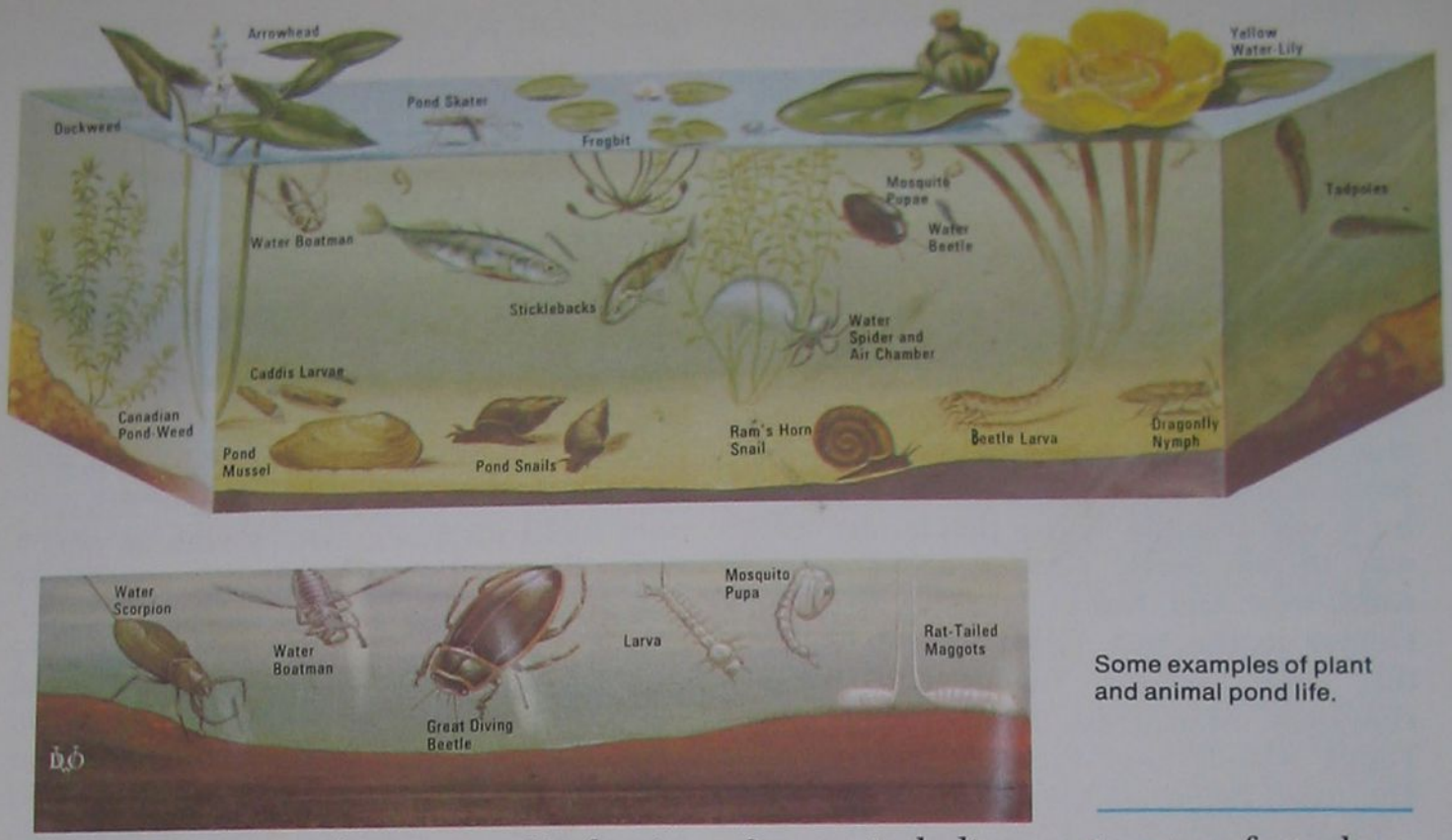
Most of the islands lie south of the Equator. Many of them are peaks of drowned volcanoes thrusting above the surface of the ocean, but others are mere atolls or coral reefs. Most of them are covered with luxuriant vegetation, which flourishes in the hot climate and heavy, seasonal rainfall.

The Polynesian people are believed to have sailed to the islands originally from India and other places on the Asian mainland. They are a tall, well-built and athletic people, with light brown or reddish brown skins and straight or curly hair. They are expert house- and boat-builders, and, probably because of the pleasant conditions under which they live, are somewhat easy-going. Their fishermen build *pirogues*, canoes with an outrigger float to keep them steady.

Polynesians are superb swimmers and divers, and are fond of music, singing and dancing. Before many of them were converted to Christianity, they believed in ancestor worship.

About one million Polynesians speak between them some 60 related *dialects.* The major language groups are those spoken by the Hawaiians, Samoans, Tahitians and the Maoris of New Zealand.

A typical house, built among palm trees, on a Polynesian island. The Polynesian people are expert house- and boat-builders.



Some examples of plant and animal pond life.

Pompeii is a ruined city near Naples in southern Italy. It was partly destroyed by an earthquake in A.D. 63, and completely buried under ashes and mud when nearby Mount Vesuvius erupted in A.D. 79.

However unfortunate for the inhabitants of the time, this catastrophe preserved much of the city for history. After excavations, which began on a proper archaeological basis only in 1748, an almost complete ancient city was revealed in a remarkable state of preservation. Not only were most of the buildings uncovered, but statues, furniture, household utensils, and even the bodies of some of its people and animals were found.

Pond life The kinds and numbers of living things found in the still water of lakes and ponds vary greatly. Ponds in clay or river deposits are often rich in life. Rushes and flowers grow around them. The common reed and the reed-mace may grow at the water's edge, often extending into the water. Truly aquatic plants may be rooted with floating leaves, such as water lilies. Others have submerged leaves, such as Canadian pond-weed. Some, including water crowfoot, have both types of leaf. Free-floating plants, which may cover the surface of small ponds, include duckweed and frogbit. Minute floating plants called *plankton* also flourish. Plants provide food and shelter for animals and also oxygen which dissolves in the water.

Each part of a pond has its characteristic inhabitants. The surface of the water forms a skin called the *meniscus* and itself supports some tiny animals. Pond-skaters and whirlygig beetles are often found skimming across the surface.

Small animals, such as *Hydra* and water-fleas, get oxygen by simple diffusion from the water. Fishes, such as sticklebacks, have gills which absorb oxygen directly from the water. Such animals can only survive when there is sufficient oxygen in the water. Many animals breathe air and surface periodically. Such animals include water-beetles, water-bugs, some fly larvae, pond-snails and mammals, such as beavers and otters.

Possibly the most numerous creatures found in a good pond (apart from microscopic protozoans) will be tiny crus-

taceans, such as *Cyclops* and *Daphnia*. The water boatman, which may attack fish, is often found. The fiercest pond insect is possibly the green and brown great diving beetle, which will attack fish.

Samples taken from weedy areas may contain hydra attached to the plants and numerous water-snails. Caddis larvae and water spiders may also be found. Water-snails breathe air at the surface.

The mud at the bottom of a pond often contains snails, worms, leeches and freshwater mussels. Freshwater mussels extract both food and oxygen from the water and keep artificial ponds clear.

Popes The pope is the head of the Roman Catholic Church. He is also Bishop of Rome, in a direct line, Catholics believe, from St Peter, the first Bishop.

The pope usually lives in Rome in the Vatican, which he rules as an independent state. He has spiritual authority over millions of people throughout the world. Sometimes the pope makes pronouncements on faith and morals *ex cathedra*—that is, from the chair of St Peter. Roman Catholics believe that such pronouncements are infallible and that the pope cannot then be wrong. Protestants, however, do not accept the pope's infallibility.

The pope has the assistance of a large administration called the *Curia Romana*. The most important advisory body is the Sacred College of cardinals to whom the pope delegates considerable responsibility. They elect new popes from their own number, and while considering their choice are shut away from the outside world. The pope's personal guard, known as the Swiss Guards, dress in fine Renaissance uniforms.

In the very early Christian Church, the Bishop of Rome was pre-eminent only in prestige. But when Leo the Great became pope in the 400's, the emperor recognized his authority over the Western Church as the defender of the true faith. Moreover, Leo twice helped to save Rome from destruction. Pope Gregory I increased Rome's prestige and power and sent Augustine to England in 597.

Pope Paul VI became head of the Roman Catholic Church in 1963. Today the pope resides in Vatican City, a small, independent state in Rome.

By the 800's the pope was the virtual ruler of Italy. In 800, Leo III crowned Charlemagne in Rome and formed a close alliance with the Frankish empire. When Innocent III was pope, from 1198 to 1216, almost every European king accepted his authority. Some rival popes were set up in opposition to the pope in Rome, and this led to the *Great Schism*, which eventually ended in 1417. The Protestant Reformation during the 1500's was followed by a counter-reformation. But the papacy was weakened when the Papal States were confiscated by Italy in the mid-1800's. In protest, Pius IX refused to leave the Vatican. The dispute was not settled until 1929, when Pius XI emerged amid great rejoicing.

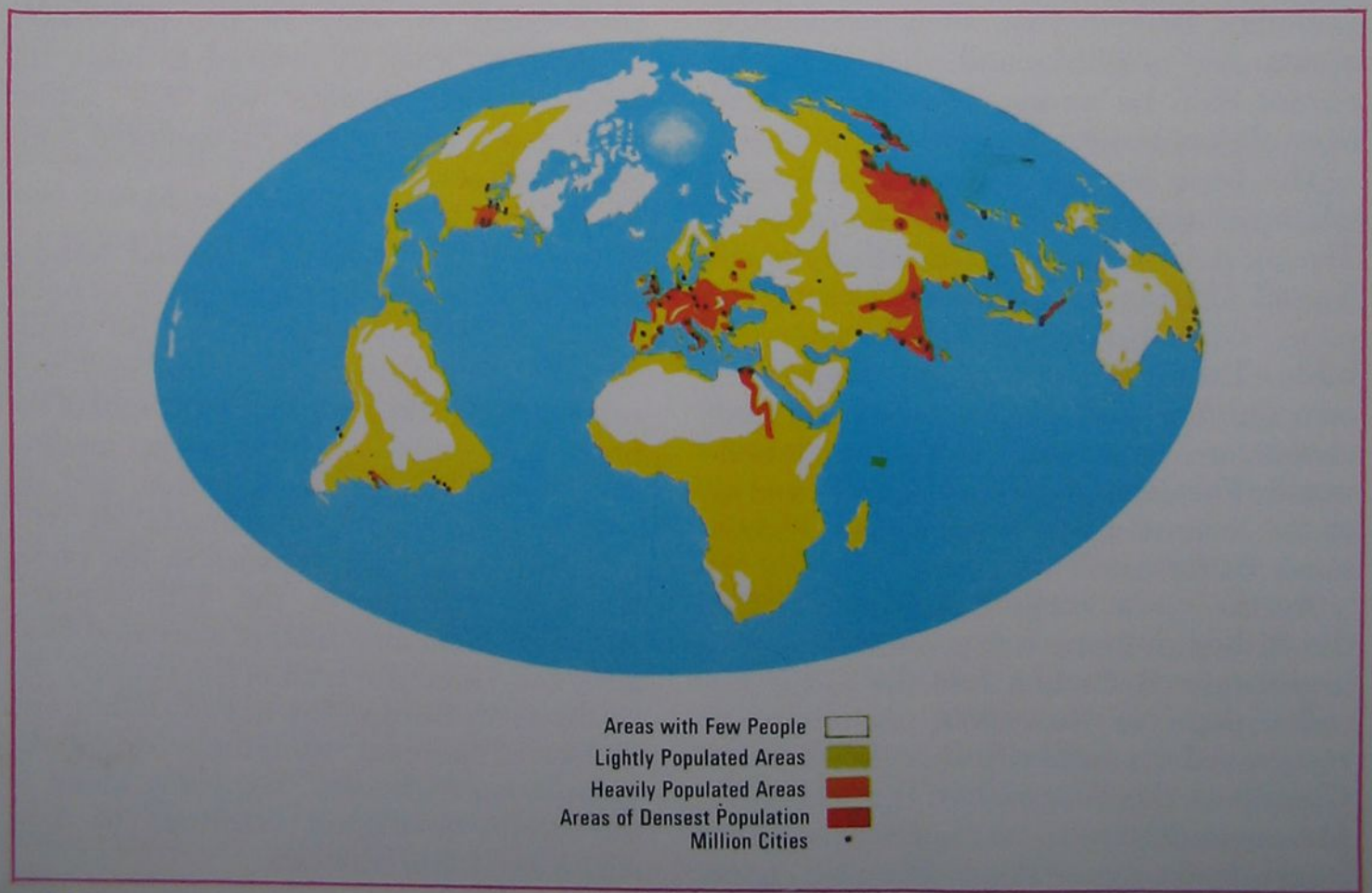
Population In 1970 the United Nations estimated the world's population as being about 3,610 millions. It is still rising rapidly, especially in Asia, and may well reach over 6,300 millions by the end of the present century. Advances in medical knowledge, improved sanitation, and superior technical developments all contributed to a rapid increase in the population in Europe in the 17th century. Between 1650 and 1900 it increased fourfold. But since the turn of the century the birthrate in Europe has steadily fallen, and the great increase, sometimes called the 'population explosion', has come about in the under-developed countries of Asia, Africa and Latin America.

Hong Kong is one of the most densely populated countries of the world. Many people live on boats.

Most of the world's population is concentrated on a fraction of the Earth's surface, in those parts where soil and climate make it comparatively easy to live. If people were spread evenly over the globe there would be about 50 people to every square mile. However, there are vast frozen wastes, deserts, high mountains and tropical forest areas, where people just cannot live and grow food. The world population is most densely massed in western Europe, the United States, the Nile Valley in Egypt, India, Java, China and Japan.

With the population rising so rapidly, many problems arise. Far more food will be needed. New lands will have to be cultivated, and existing lands made to produce more crops. Scientists are already working to find new strains of crops that can be grown in places hitherto thought unsuitable for cultivation. There are now farms beyond the Arctic Circle, and serious study is being given to evolving methods of producing food from the sea. New irrigation methods and new fertilizers are also being evolved, and an all-out war on plant pests and diseases is being waged to reduce wastage.

The reclamation of arid lands by means of dams and irrigation schemes is of prime importance, particularly in India and Asia, where terrible droughts and crop failures often bring dreadful prolonged famines. The greater population problems are in poor countries in Asia, Africa and



Tilbury Dock lies on the Thames east of London.

Latin America, which are far below the level of development elsewhere, and have few industries.

Porcupine This is a mammal that looks rather like a pin-cushion on legs. The whole of its back is covered in long, sharp spines. They normally lie flat, but they stand on end when the animal is attacked. They form good protection, and if necessary the porcupine may run backwards to stab its attacker.

The African porcupine lives in forests.

There are two main groups of porcupines: those living in the Americas and those living in Europe, Africa and southern Asia. Both are forest dwellers.

Ports and harbours Ports are places where ships can load and unload their cargo and passengers. They may be situated on harbours or on river estuaries. They provide facilities for berthing ships and handling and storing their cargo. They must have good road, rail, or water communications so that goods and passengers can be speedily transported. Large ports have facilities for repairing vessels, too.

The ports of Sydney and Rio de Janeiro are situated on *natural* harbours. A narrow opening between two headlands leads to a sheltered stretch of water. Dover and Los Angeles lie on *artificial*

Portofino is a fishing port near Genoa, on the north-western coast of Italy.

harbours. A protective wall called a *breakwater* has been built out into the open sea to enclose and shelter an expanse of water. London and Antwerp are ports which lie on river estuaries.

The way in which a ship *berths*, or moors, to unload its cargo depends on the rise and fall of the tide. Where the tide is not too great, the ship berths alongside a *quay* or a *jetty*. The quay is a built-up section of the waterfront. A jetty is a structure built out into the water at right angles to the quay.

In ports such as London (20 feet) and Bristol (40 feet), the rise and fall of the tide is too great for quays and jetties to be used. *Docks* are used instead. A dock is an enclosed basin which is filled with water at high tide. The ship enters the filled dock through lock gates, and the gates are sealed shut. When the tide falls outside the dock, the ship inside is not affected.

A wide variety of mechanical handling equipment is used on the dockside to handle cargo, including travelling cranes with slings and nets, suction elevators (for grain), and electric fork-lift trucks. In the early 1970's, more and more cargo began to be carried in *containers*. These large steel boxes are packed and unpacked far away from the docks. The introduction of containers has made docking much more efficient and one man with a crane can unload a ship in a fraction of the time that a large work gang of dockers would once have taken to do the job.

Repairs to ships are done in *dry docks*. They are docks from which the water can be pumped out, leaving the ship inside high and dry. A *floating dry dock* can be sunk low in the water so that a ship can enter it. Then it can be raised up out of the water to lift the ship clear.

Portugal is a small country in south-western Europe with a long Atlantic coastline. Spain lies to the north and east.

The land is mountainous on the border with Spain, and in an area called the

Opposite: The steep sides of Portugal's mountains are terraced for agriculture. Below: Much wine is made from the grapes grown in Portugal's many large vineyards. Bottom: Farmworkers pause for a break on a hot summer day.

An ancient fortress by the sea near Lisbon. Portugal was once a great maritime nation.

among early settlers in Portugal. From the 700's to the 1200's, Muslims from northern Africa ruled most of the land. Christian warriors drove them out. Northern Portugal became independent in 1143. From the 1400's, the Portuguese seamen opened up sea routes throughout the world and founded many colonies. Portugal fought in World War I but remained neutral in World War II. In 1961, Portugal lost possession of Goa, when Indian troops seized it. Uprisings occurred in other Portuguese territories in the 1960's, but, unlike most European countries, Portugal has retained posession of her colonies.

Facts and Figures
Area: 35,510 square miles.
Population: 9,600,000.
Capital: Lisbon.

Algarve, in the far south. A lowland plain lies along the coast and in the deltas of the Douro and Tagus rivers. The mountains are covered with forests of pine, chestnut, eucalyptus and cork oak, which provides more than half the world's supply of cork. Winters are mild, and the summers pleasantly hot.

Most Portuguese are Roman Catholics. About two-fifths of them work on farms. They grow such crops as oranges, lemons, tangerines, olives and rice. Grapes are grown as a food. They are also dried as raisins, or used for making wine. The best-known Portuguese wine is called *port*, which is made from grapes grown in the Douro valley. It is named after Oporto, a city at the mouth of the Douro.

Many people are fishermen, whose chief catch is tunny and sardines. Others mine wolframite (tungsten ore), iron ore, copper, lead and kaolin. But much of the mineral wealth is undeveloped.

Portugal's industries are expanding. Factories can sardines and make wine and olive oil. Textiles and tile-making are leading industries.

Phoenicians, Romans and Goths were

Postal services Men have always wanted to send messages. The Indians in North America used smoke signals. In South America, the Incas stationed pairs of runners about a mile apart along all the main roads. They ran to the next post where they handed messages to another relay of runners. At first the messages were scratched on beans but later carried by quipu (knots in ropes). Han China had post offices, with relays of horses, every mile or two along the roads.

Much later, a similar system was used in the famous, though short-lived, Pony Express, which linked eastern and western America between Missouri and California during 1860-61.

Today every country has its own postal services. In Britain, Oliver Cromwell set up a Post Office under a Postmaster-General in 1657, to carry everyone's letters. The service was very expensive until Penny Post began in 1840. Sir Rowland Hill (1795-1879) introduced this and the stick-on stamp. William Mulready (1786-1863) designed the envelopes. Hill's idea was that more people would use the post, if there was a standard rate

This *glacis* in a modern post office sorts parcels from letters. Equipment like this helps to speed the ever-increasing numbers of letters on their way.

over all distances. Today we have different rates for home and foreign postage.

In recent years, postal services have been streamlined by the mechanical handling of mail. Machines have been installed in some post offices which automatically separate parcels from letters, scan each envelope for stamps to the correct value, and apply a postmark. In a sorting machine, letters are moved automatically one by one past a viewing window, and the operator can direct them to any one of many stacking boxes merely by pressing keys. In some places, postal codes have been allocated to each street or part of a street. The codes speed up the preparation of letters for delivery. When letters are being sorted by machine the operator 'types' the postal code on the machine's keyboard instead of having to remember in which delivery zone the house is situated.

Talking points

* The invention of the telephone has made it possible for people to speak direct to each other although they are miles away from each other. In what circumstances should you write a letter rather than use the telephone?
* Postal codes have been introduced in many countries to speed up the delivery of mail. Discuss why it has been necessary to do this.
* Find out the journey taken by a letter from the time that you put it in the post box to its arrival at its destination. What different means of transport are used to get it there?

Articles to read

Communications; Stamp-collecting; Telephone.

Potatoes are important vegetables that can be cooked in various ways – baked, boiled, or fried. Potatoes are a root crop, although the part we eat is not the root but the *tuber*, a swollen underground stem in which the potato stores its food.

Potatoes originally grew in the highlands of Peru and Bolivia in South America. The Indians grow potatoes there instead of maize, and still make bread with flour ground from dried potatoes. Spanish explorers introduced the potato into Europe in the mid-1500's, and it is now an important crop in temperate regions throughout the world. The world's leading potato-growing country is Russia,

followed by East and West Germany, France and Poland.

Potatoes are planted afresh every year. Farmers plant selected tubers and new plants grow from the buds or 'eyes'. The tubers which grow on these plants are ready to be lifted from the soil after three or four months as *new* potatoes. But they can be left in the soil and harvested later if required.

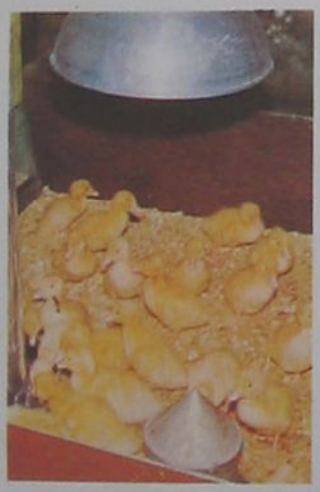
Poultry are birds such as chickens, ducks, geese and turkeys that are kept on farms for their meat and eggs. They are also known as *fowls*.

Poultry meat and eggs account for about 15 per cent of all income received from farm livestock. Half of this amount is obtained by the sale of chickens' eggs. Chickens are descended from the red jungle fowl of India. Breeding to increase the egg output is a fairly recent development. Formerly, chickens were kept mainly for their meat.

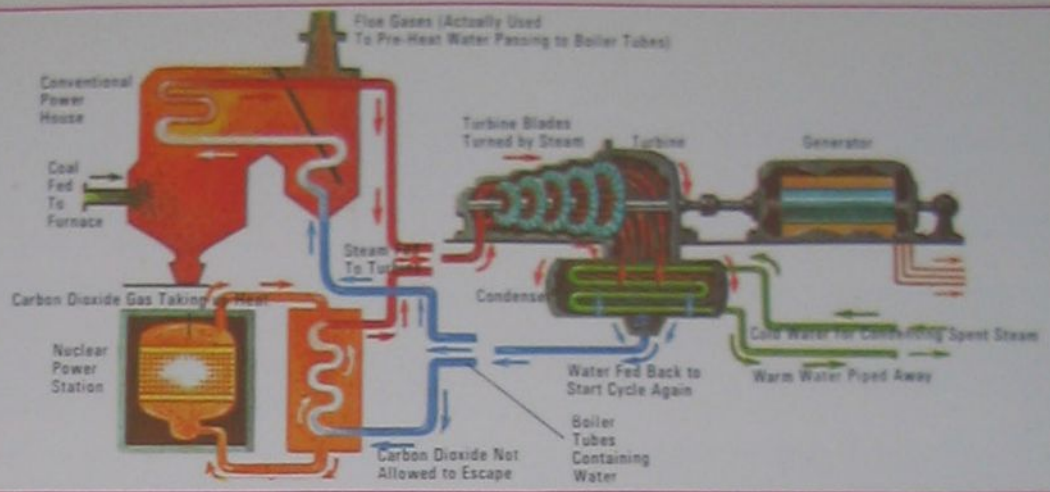
Peacocks, and gamebirds like pheasants, partridges and quail, are also poultry but are not often farmed as food.

Most poultry farmers have found that it is more profitable to keep their poultry indoors. The young chickens grow in clean and warm conditions, but never see the light of day. They are fed a special diet that causes them to grow to maturity faster than *free range* chickens (those that are raised out of doors). When they are about 12 weeks old, they are killed and sold for broiling and frying. Larger birds such as ducks and geese are usually reared in the open.

Power station Electricity is our most important source of power, but we cannot yet produce it directly from a natural source of energy, such as coal or water. First we must convert this energy into mechanical power to spin an electrical *generator*. This is what happens in a power station.



The rearing of poultry is today a major farm industry. The demand for eggs and meat from poultry has greatly increased and poultry farming is now highly organized to obtain maximum production.



In a power station, heat energy is converted into electrical energy. The heat may be derived from burning coal or from nuclear reactions. But whatever the source of heat, hot gases turn water in the boiler tubes into steam which passes into the turbine. The revolving shaft of the turbine drives the generator. The steam condenses and is returned to start the cycle again.

The two most important kinds of stations are those which burn fuel to produce steam and those which harness the energy of falling water. (See Hydro-electric power.) In these stations, the steam or the rushing water spins *turbines* which are connected to the generator.

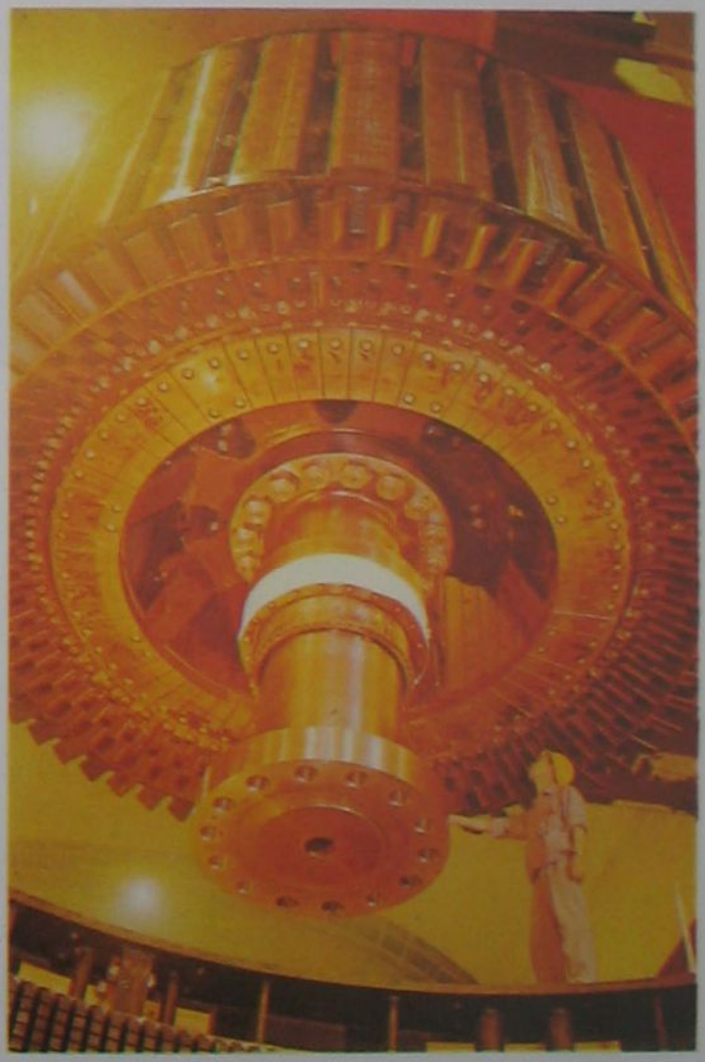
Two-thirds of the world's power stations are steam-operated. The most common fuels are coal and oil. They are burned to heat water in boilers to produce steam at a high temperature and pressure.

Several countries have nuclear power stations which use uranium as fuel. Heat is produced when the uranium atoms split. (See Nuclear energy.) Thereafter, it is used to produce steam and spin turbines as in conventional stations.

Once the electricity has been produced, it must be distributed to consumers many miles away. This is done through cables, or *transmission lines,* often carried above ground on pylons. The voltage, or 'pressure', of the electricity produced by the generator is not high enough for transmission over long distances. Therefore, it is 'stepped up' by a device called a *transformer*. It is transmitted in this form to local sub-stations which step it down low enough to be used by the consumer.

The various power stations in a region, or even a country, are connected with one another by what is called a *grid system* of power lines. This means that electricity from one station can be sent to another when the other is overloaded.

Giant turbines are used to drive generators in power stations, producing enormous quantities of electricity.



Included in the grid are small, standby power stations that are used only at times of peak demand, when the system is overloaded. Many have generators powered by diesel engines or gas turbines, which can be started up at short notice.

Wheatfields stretch across the prairies for mile after mile.

Prague, the capital of Czechoslovakia, is one of Europe's most beautiful cities. It is situated on the hilly banks of the river Vltava (also called the *Moldau*) in the western part of the country. Prague's historic buildings include the cathedral of St. Vitus, which contains the tomb of 'Good King Wenceslaus'; Hradcany Castle, formerly a royal palace and now the seat of Czechoslovakia's president; and several other splendid churches and castles.

Prague is a major trade and communications centre for central Europe. Its industries include the manufacture of transport equipment, machinery, clothing, chemicals and beer. After it became the capital of Bohemia in the Middle Ages, it developed into one of Europe's leading cities. From 1620, when Austria conquered Bohemia, it belonged to the Habsburgs. When Czechoslovakia was formed in 1918, after Austria's defeat in World War I, it became the country's capital.

Prairies The term *prairie* comes from a French word meaning meadow, or grassland. It was originally used to describe the wide plains French explorers found in the Mississippi valley, and in Canada west of the Great Lakes. Prairies are found roughly midway between the Equator and the Poles, in the middle latitudes. Summers in these regions are hot, and winters cold, and the rainfall is moderate, occurring mainly in summer. Grass grows rapidly in spring and becomes hay in autumn.

In former times the great herds of bison (buffalo) ranged the North American prairies and were a source of food for the Indians. European settlers first used the prairies as cattle ranches and, later, started huge wheat farms. Great herds of cattle are now reared on the prairie ranges in the states of Montana and Wyoming. Mile after mile of wheat and

cereals are also grown. Trees are rare, except along banks of rivers.

South American prairies are called *pampas*. They support great herds of cattle and horses, originally brought there by Spanish settlers. In the eastern parts of the pampas, where the rainfall is heavier, wheat, maize, and flax are grown. The pampas probably got their name from an Indian word for *plain*. They are found mostly on the vast, almost treeless, areas around the Río de la Plata in Argentina, where the tall 'pampas grass' occurs. The lower rainfall in the western part makes the area almost a desert. But in general the climate is warm and temperate, though a strong cold wind from the south, known as the *Pampero*, can break the summer heat.

Precious stones are minerals or stones which are highly prized for their beauty. They are used in jewellery. Precious stones are dug up from the ground. They become beautiful only after skilled workers grind them into shape and polish them to bring out their brilliance or glow.

The diamond, the hardest known mineral, is among the mostly highly valued of all precious stones. It is a pure form of carbon. The carbon was probably changed into diamonds by great heat and pressure in the Earth's crust millions of years ago. Most diamonds are mined in Africa. (See Diamonds.)

The most precious diamonds are colourless. Other precious stones are valued according to the quality of their colour. For example, rubies, which come largely from Burma, Ceylon and Thailand, are blood-red. Many fine blue sapphires have been found in Thailand. Beautiful green emeralds have been found in Colombia, India, Rhodesia and Russia. Imitation stones are now widely made from a soft glass, but they are easily scratched

Prehistoric animals lived during the period called 'prehistory', before written records existed. Our knowledge of them comes from fossils preserved within the rocks (see Fossils). More than 600 million years ago, the first living things appeared in the sea. They were soft creatures, like tiny blobs of jelly. Light and boneless, they floated wherever the waves took them. In time, however, they began to develop hard protective shells. These hard-shelled animals were more complicated creatures, and were able to live differently from their ancestors. The *trilobites*, for example, which had legs, feelers and large eyes, lived in shallow water, and crawled along the bottom searching for food.

All of these early inhabitants of the sea were *invertebrates*—that is, they had no backbones. Fish and lampreys (eel-like creatures) were the first *vertebrates*, or animals with backbones. Just as modern fish do, these ancient ones breathed through gills and swam about freely. Yet by comparison with a herring or a plaice,

These stones, cut in different ways, are all varieties of beryl. Its crystals come in several colours, including dark green emeralds and paler aquamarines.

these fish were quite fantastic looking. Their heads and a large part of their bodies were armoured with sheets of solid bone or bone-like material.

The animal population was growing very varied. But as yet all animals lived in the water—although plants had invaded the land millions of years before. It was difficult for sea animals to conquer the land, for a fish out of water cannot breathe. Fishes had to evolve into air-breathing animals before they could survive on land. This evolution was forced upon them by a warm, dry climate that periodically dried up rivers and lakes. Gradually a new kind of animal developed, one which could live both on land and in water. This was the *amphibian*.

Amphibians were the first true land-dwellers. For many millions of years, they remained fish-like in appearance, while their short limbs and other features became more suited to life on land. The amphibians, however, never came to dominate the Earth, as their descendants, the *reptiles*, did later. The amphibians were tied by the fact that they had to return to the water to breed.

Reptiles were the first animals to be completely independent of the water. Scaly-skinned, sometimes armour-plated, reptiles of all sizes ruled the world. Among them were the *dinosaurs*, or 'terrible lizards' (see Dinosaurs). There were huge plant-eating dinosaurs, higher than houses, and fierce meat-eaters with teeth six inches long. Some reptiles returned to live in the sea. Others took to the air. The wings of these flying reptiles were featherless flaps of skin.

Flying reptiles were not the first conquerors of the air. Insects had preceded them by 100 million years. But the flying reptiles did not survive. They were replaced by the birds—the feathered descendants of reptiles, but *not* of the flying reptiles.

The *mammals* also descended from reptiles. Mammals, like birds, are warm-blooded creatures. This means that they are better able to adapt to changes in climate than were any of the Earth's earlier animal inhabitants. Apart from the strange duck-billed platypus and its allies, mammals bear their young alive. They also nurse their babies on milk, and protect them for longer than other animal parents do. But the greatest advantage which mammals possess is their superior intelligence. Even the stupidest mammal is far ahead of any reptile in mental development and ability.

The earliest mammals appeared during the dinosaur age. While those giants stalked about, the mammals remained tiny and shrew-like, living on insects, eggs—any food that they could find. From these small beginnings, the mammals grew to be the dominant creatures on Earth.

The most intelligent of all mammals is man. A late developer in prehistoric terms, men have existed for only about one million years. The question of man's direct ancestors is the subject of continuing debate among scientists (see Prehistoric Man).

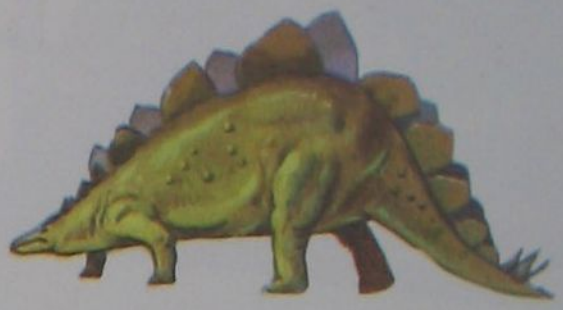
Prehistoric Man Prehistory (before history) is the name given to early times about which we have no written records. We know about such times mainly from the objects people made (see Archaeology). The discovery of writing occurred when

A reconstruction of the skull of Pithecanthropus, a primitive man who lived about half a million years ago.

Eras	Periods and Years ago When They Began	Events
PALAEOZOIC	**Cambrian** 600 million	Trilobites and worms
	Ordovician 500 million	First fishes
	Silurian 440 million	First life on land
	Devonian 395 million	Amphibians
	Carboniferous 345 million	First reptiles appeared
	Permian 280 million	Reptiles increased. Modern insects developed
MESOZOIC	**Triassic** 225 million	Earliest dinosaurs
	Jurassic 195 million	First mammals. First birds. Giant dinosaurs
	Cretaceous 136 million	Increase of mammals. Dinosaurs became extinct
CENOZOIC	**Tertiary** 65 million	Mammoths and other large mammals
	Quaternary 1,500,000	First men

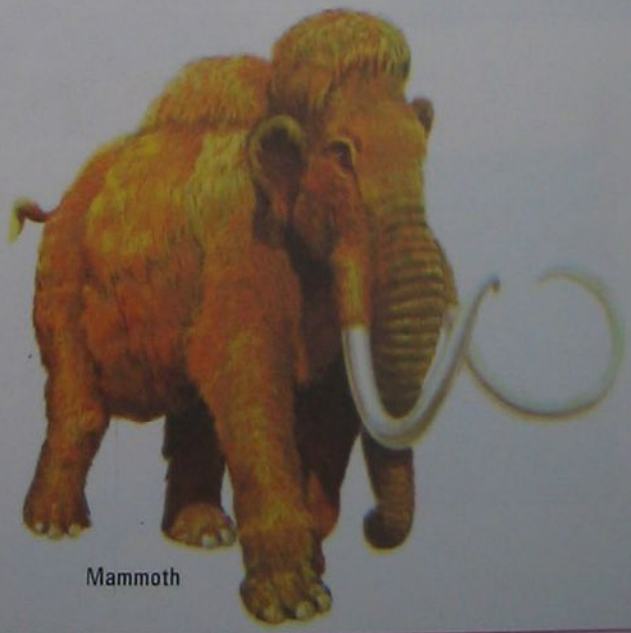
Trilobite

Early Amphibian



Stegosaurus

Archeopteryx



Mammoth

The Earth was formed between 5,600 and 4,500 million years ago. The earliest primitive life began in Pre-Cambrian times, about 3,000 million years ago, but little is known about it. Geologists divide the history of the Earth into major divisions called *eras.* The three most recent eras are divided into *periods.* Fossils in rocks of each period show us when the various creatures appeared.

craftsmen and merchants came into existence and towns were built. Prehistoric man did not live in towns; he was a wandering huntsman and later a villager.

Man is unique among the animals because he can make tools and talk. By talking, men passed their skills on to others. Man advanced as he learned to use new tools, to make more and better things. Prehistory is divided into periods named after the material Man used for his tools: Stone, Bronze, and Iron Ages. Man's advance was very slow at first, so the long Stone Age is divided into the Palaeolithic (old stone), Mesolithic (middle stone) and Neolithic (new stone) ages. Palaeolithic hunters lived during the Ice Ages, when mammoths roamed the margins of the glaciers in Europe, Asia and North America. For hundreds of thousands of years they gradually improved their flint tools.

As the last Ice Age ended, Mesolithic societies appeared. They were fishermen and food gatherers. They domesticated dogs. Most fish traps, nets and knots date

Prehistoric men once used stone and flint tools. The flints and arrowheads (top) were discovered at a prehistoric lakeside settlement. Some early men hardened the tips of spears by fire (above). The Australopithecus (right) may have hunted baboons with primitive weapons.

Caves in Spain, France and Italy contain wall paintings, clay models and bone carvings made by prehistoric men. Most show animals but a few also depict people.

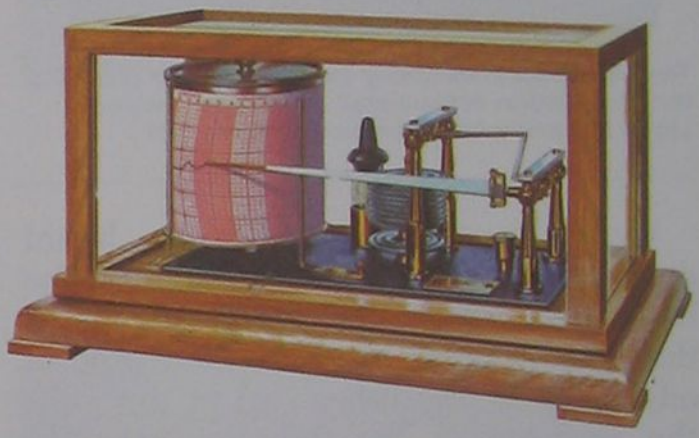
back to Mesolithic times. The Neolithic Age began when women in western Asia learned to farm, to make pots which held food, and to spin and weave. The men continued to hunt.

The Stone Age ended when men learned to melt ore and make metal. Copper was smelted first. Mixed with tin it made the stronger bronze. This advance coincided with the invention of the plough and the discovery of how to use animals to drag ploughs and sledges. Soon wheels were invented and wheeled carts and chariots appeared. Iron, a much harder metal than bronze, began to be widely used about 1000 B.C. Civilization first appeared in the Middle East and Asia around the great rivers of the Nile, the Euphrates and the Indus.

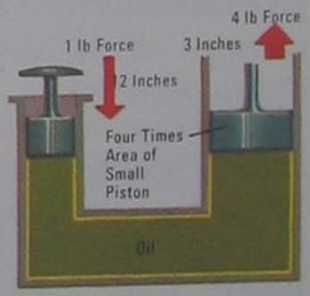
Pressure is the force exerted by a gas or a liquid. We live at the bottom of a vast ocean of air, the atmosphere. The weight of air over our heads presses down on us with a pressure of about 14 pounds on every square inch of our bodies. This pressure is less if we go to the top of a mountain because there is less air above our heads. Higher up in the atmosphere, where jet aircraft fly, the pressure is very low and insufficient for men to breathe. For this reason, all high-flying aircraft have pressurized cabins, in which the pressure of the air is kept the same as that near the ground. Air pressure is measured with a barometer. Because changes in the weather occur when the air pressure varies, barometers are used in weather forecasting. (See Barometer.)

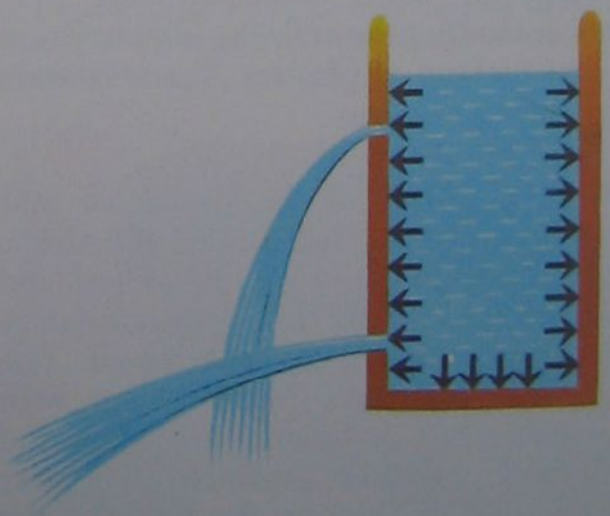
Pressure exists in the sea as well as in the atmosphere. At the deepest point in the ocean, the pressure of the water bearing down on the bottom is eight tons per square inch. Men can travel to this depth in a *bathysphere*, a craft with strong steel walls that can resist this pressure and enable the crew to breathe air at normal pressure. But divers have to breathe air at the same pressure as the water pressure at the depth they have reached. At such high pressures, nitrogen gas in the air dissolves in the blood and causes ill effects. As a result, men have to breathe special gases to dive to depths of more than 300 feet.

Many other gases dissolve in liquids at high pressure. Fizzy drinks contain carbon dioxide gas dissolved at high pressure. When you take the cap off the bottle, the drink bubbles as the gas leaves the solution.



Top: The barograph records the pressure of the air.
Right: A force of one pound moving through 12 inches does the same work as a force of four pounds moving through three inches, so the jack in this case multiplies forces fourfold.
Below: Pressure is greater at the bottom of a full tank than near the top.





The bathysphere has strong steel walls which resist the terrific pressures encountered deep under the sea. Lights illuminate the darkness on the sea bed.

Hydraulic machines work by liquid pressure. When you put your foot on the brake pedal in a car, it pushes a piston that creates high pressure in a pipe of oily fluid. At the other end of the pipe, the pressure of the fluid operates the brakes. Hydraulics can be used to operate powerful mechanisms, such as the undercarriage of an aircraft or a mechanical digger, or a jack.

A vacuum is a complete lack of air pressure. Vacuums are used in cathode-ray tubes in television sets, and in vacuum flasks for keeping hot liquids hot or cold liquids cold. High pressure is necessary to carry out many manufacturing processes, including the refining of petroleum and the making of plastics. Tyres contain air at high pressure.

Pretoria is a city of the Transvaal and the administrative capital of South Africa. It is the residence of the President and ministers of State, but parliamentary sessions take place in Cape Town. The city is an important trade centre with large industries in engineering, iron and steel, and chemical products. The city was founded in 1855 on the banks of the Apies River, and now has a population of 422,000. The principal administrative buildings occupy a prominent position on the Meintjeskop hill overlooking the city. The city is noted for its many jacaranda trees with their beautiful mauve flowers.

Priestley, Joseph (1733-1804), an English nonconformist minister, made several important discoveries in chemistry. In 1774 he discovered 'dephlogisticated air', which we now call *oxygen*, though he did not realize the part it plays in burning. He prepared and studied carbon monoxide, ammonia, sulphur dioxide and other gases. By dissolving carbon dioxide in water, he invented soda water. Priestley's other scientific work included studies of plant life, and a book on electricity.

Priestley was born in Yorkshire, and wrote books on religion, philosophy and education as well as on science.

Prince Edward Island is one of the Atlantic provinces of Canada. It lies in the Gulf of St. Lawrence. The Northumberland Strait separates it from New Brunswick and Nova Scotia on the mainland. The island has a milder climate than most other parts of Canada.

Government buildings stand in pleasant surroundings in Pretoria, the administrative capital of South Africa. Parliamentary sessions take place in Cape Town.

Prince Edward Island is the smallest of Canada's provinces. Its area is 2,184 square miles. The land is flat. The island is known for its fertile, red soil. Villages and small towns dot the countryside. Charlottetown is the provincial capital.

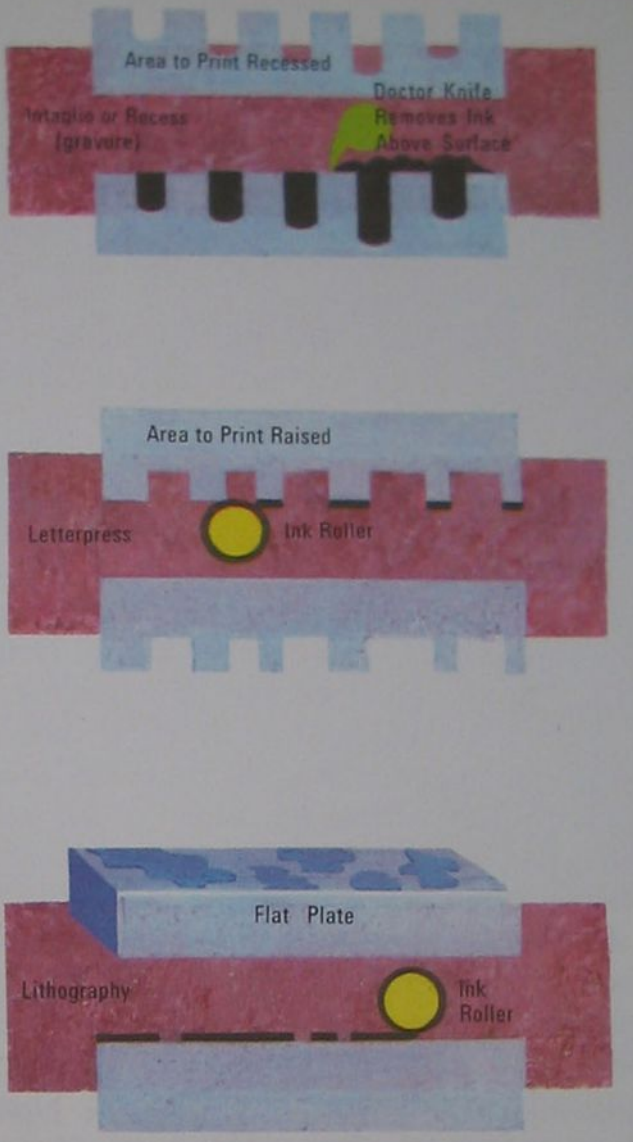
Prince Edward Island has a population of 109,000. Most of the people are of British descent. Farming is the chief occupation on the island. Potatoes are the leading crop. Cereals, vegetables and fruit are also produced and there are many dairy farms. Fishing is another important occupation. Lobsters, oysters, cod, herring and mackerel are the main catches.

The Micmac Indians inhabited the island long before the first white explorers arrived there. Jacques Cartier, a Frenchman, landed on the island in 1534. Samuel de Champlain claimed it for France in 1603. Colonization began in the 1700's. Britain acquired the island in 1758 as a result of the French and Indian Wars. In 1799 the island was given its present name in honour of a son of King George III.

In 1864, delegates from various parts of Canada met in Charlottetown to discuss forming a federal union. The building in which they met is often called 'The birthplace of Canada'. But when the Dominion of Canada was formed in 1867 Prince Edward Island did not join. It joined six years later.

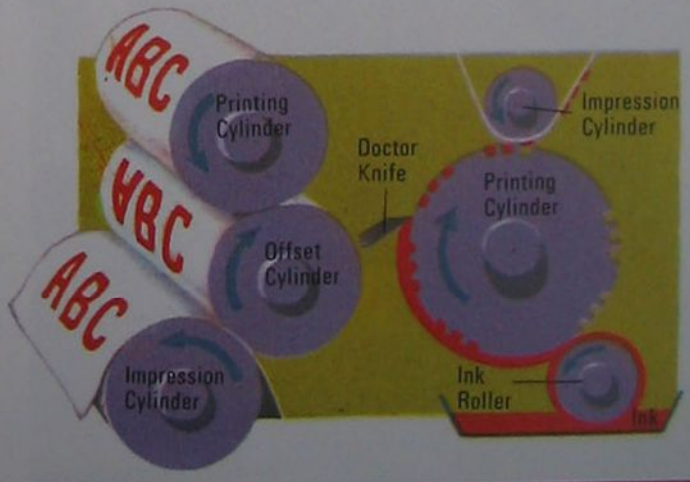
This map shows the location of Prince Edward Island.

Printing Before the 1400's, books were written or copied by hand in Europe. They were rare and expensive and far



Top: The three basic printing processes. In intaglio or recess (gravure) printing, the design is cut into the plate. In the letterpress process, it is the raised parts of the plate which deposit colour on the paper. Lithographic plates are flat and this is called *planographic* printing.

Below: The diagram shows the essential differences between printing by off-set lithography and rotary photogravure.



beyond the reach of the ordinary man. In about 1456, Johannes Gutenberg published copies of the Bible printed from movable metal type on a printing press. Books could at last be produced in some quantity instead of one at a time. So began a revolution in communications that has brought knowledge within the reach of everyone who can read.

The *copy* (words) for a book, say, generally arrives at the printer's in the form of a *typescript*. The first job of the printer is to set the copy in even lines of *type*. The type is set in the *composing room*, generally by machines. In the most common processes, the letters are cast in hot metal in tiny moulds. In the *Monotype* machine, each individual letter is cast separately. The operator first types the copy on a machine which produces a punched paper tape. He then feeds the tape into a casting machine which sets the lines, letter by letter, automatically. Monotype is generally used for books.

In the *Linotype* machine, each line is cast in one piece, called a *slug*. The operator types out the copy on what looks like a giant typewriter. Linotype is used widely for newspapers. Some newspapers can be printed in several towns at once from the same copy by *teletypesetting*. Signals representing the copy are sent by wire to special Linotype machines which automatically set the copy in type.

A more recent method of setting is *film setting*, in which type is set on a sheet of photographic film or paper.

After setting, the type is made up into the form of pages. Subsequent processes depend upon which method of printing is to be used.

Letterpress printing is the most common method. Printing is done by inking the raised surface of the type and pressing it against the paper *(relief printing)*. On a *cylinder press*, the made-up type is placed flat on a bed, which moves back and forth. The paper is pressed against it by a revolving cylinder. On the *rotary press*, printing is done from a rotating cylinder. Curved metal plates made from the type form the printing surface. Rotary presses can be fed with continuous reels of paper and can therefore work much faster than flat-bed presses.

Offset-lithography, or *litho*, is a method of printing from a flat surface *(planographic* printing). The flat printing plate is made photographically from a printed copy of the made-up type. It is treated chemically so that it attracts greasy ink only on the parts where the image is.

Printing takes place on a rotary press with three cylinders, one above the other. The printing plate transfers, or offsets,

A great deal of modern printing demands the rapid production of a large number of copies. Highly automated modern gravure machinery like the Cerutti press (below) permits long runs at great speed.
Left: The web offset process.

an inked image to the middle roller, which in turn transfers it to the paper pressed against it by the third roller.

Sometimes the printing plates are made directly by photographing the original typescript copy, without setting it in type. This is called *facsimile* printing.

Photogravure, or *gravure,* is used mainly for illustrations. It is a method of printing from a pitted, or recessed plate (*intaglio* printing). It is thus the reverse of relief, letterpress printing.

So far we have considered only the reproduction of words. Now let us see how pictures are reproduced. It is quite simple really. The picture is itself photographed but through a special screen, which reduces it to a series of dots. The film produced can be used directly in the litho process. But in the letterpress process, it must be converted first to a metal block, or *engraving.*

Colour pictures, too, can be reproduced in a similar way, only the colours are first split into different shades of red, yellow and blue. Separate printing plates corresponding to these colours are then made.

After all the pages have been printed, the sheets must be trimmed and folded and may be stitched and bound with covers into their final form.

Prism, in geometry, is a solid figure. The commonest form of prism is shaped rather like the roof of a house: it has triangular ends and the three other faces are rectangles. But the end of a prism can be any shape.

Triangular prisms made of glass are used in optical instruments. Light shining into a prism may be reflected round the interior, and so prisms are used instead of mirrors in periscopes, binoculars, and reflex cameras. When white light passes *through* a prism, it is refracted (bent) and separated into its component colours to form a spectrum.

A prism splits up a ray of light into bands of colours called the *visible spectrum.* A second prism placed upside down re-combines the colours to produce white light.

The massive gates of an old-fashioned prison. Prisons built today are less forbidding; the idea is to help prisoners, not just shut them away.

Prisons are institutions in which wrongdoers are detained, partly as a punishment and partly in the hope that they will be reformed. Enlightened administrators have tended to emphasize the second aim, and prisons are gradually becoming less forbidding if not less crowded.

Many *closed* prisons consist of small cells radiating like the spokes of a wheel from an observation room in the centre. Prison officers, sometimes called *warders,* patrol the corridors and landings. Most

prisons also have a chapel, a library, workshops, and exercise grounds. A high wall, sometimes manned by armed guards, surrounds the buildings. This is the picture of a typical old prison in Britain, the United States, and most other countries.

But penal reformers have pointed out that in such surroundings prisoners are unlikely to solve their personal problems and become useful citizens. Many governments have established *limited-security* and *open* prisons. In limited-security prisons, prisoners still live in cell blocks but can work on the land or in workshops outside the prison. They are allowed to associate comparatively freely with their fellow prisoners. Prisoners in open prisons are not restrained by cells or bars. They are free to work for outside employers and to come and go virtually as they wish. In many prisons, prisoners can attend educational classes, watch television and take part in amateur dramatics.

But whatever privileges prisoners enjoy, they still are not free. Many are violent men who must be kept under strict guard. If prisoners behave well they may gain *remission* (a reduction in sentence) or be allowed out on *parole*. If prisoners on parole commit an offence they go back to complete their original sentence. Dangerous criminals who might escape and become a menace to the community are confined in *top security* prisons that are equipped with closed circuit television and other modern equipment designed to make them escape proof.

Talking points

* During World War II, many escapes were made from German prisoner-of-war camps. Why do you think that there are so few successful escapes from modern prisons?
* Discuss the effect that ten years imprisonment might have on a criminal. Do you think that he would be a reformed character when he was released?
* Men in prison are often given a boring job to do, such as sewing mail bags. Do you think that they could be employed in more interesting jobs while serving their sentences?

Articles to read

Crime; Fry, Elizabeth; Laws.

Propaganda The word propaganda comes from the *Congregatio de propaganda fide*, the Congregation for the Propagation (spreading) of the Faith, a body set up by the Roman Catholic Church. Propagandists are people who have some particular belief and try to convince everyone that their belief is correct. They may argue in favour of religions, political parties or even, in advertising, for a commercial product.

A Chinese crowd in Shanghai studies propaganda posters which attack groups opposed to the communist government.

Water (right) can be a solid (ice), a liquid, or a gas (water vapour). The differences between ice, water and water vapour lie in the activity of the molecules, as shown above.

But people sometimes conceal one side of the argument and so the term propaganda sometimes means using false arguments. Propagandists in political parties sometimes try to excite and influence people by holding large meetings with music. Their supporters may wear uniforms, like the Nazis in Germany in the 1930's (see Nazism). Propagandists may even control radio and television so as to conceal the views of others.

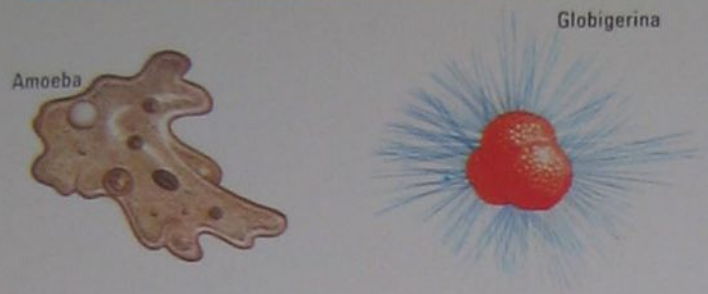
Properties of matter All substances take the form of a solid, liquid or gas. Many can exist in all three forms, depending on the conditions. (See Matter, states of.) In addition, substances have several other properties, such as density, and strength and elasticity if solid, and viscosity if liquid. These are the properties of matter possessed by a substance.

All liquid or gaseous substances become solid if they are cooled to a sufficiently low temperature. Helium, which is a gas at room temperature, is a solid at temperatures below −271° C (−456° F). On the other hand, tungsten is a solid metal at temperatures up to 3,410° C (6,170° F). At this temperature, the melting point, the solid becomes a liquid. If heated further, a liquid will eventually boil and become a vapour or gas.

The differences between a solid, liquid and gas lie in the activity of its *molecules* or *atoms*. All substances are made up of these minute particles, and in solids they are packed closely together, like people in a crowd. This gives solids a definite shape and volume of their own. In liquids, the molecules move about within a certain space, like people on a dance floor. Liquids have a definite volume but no shape. They find their own level but have to be kept in a container. In gases, the molecules move freely about, and gases will fill any available space. They can be kept only in a closed container.

The closeness and size of the molecules gives a solid, liquid or gas its *density*. This is the weight of a substance divided by its volume, gases are substances which have low densities and solids ones with higher densities.

The arrangement of molecules in a solid gives it *strength* and *elasticity*. That is why rubber is elastic and wood is not. The size and shape of molecules in a liquid gives it *viscosity*. Treacle flows very slowly and has a high viscosity, whereas water has a low viscosity.



Single-celled animals include 'jelly'-like amoeba and globigerina (above). Globigerina float about in warm seas and their shells pile up on the sea bed to form chalk. Single-celled plants include the pleurococcus and the closterium (below).

Protozoans are the simplest kinds of animals. They consist of a single, minute cell of *protoplasm* (the living substance of all plants and animals) containing a *nucleus*, the control centre of the protozoan. All other animals contain many cells. Protozoans live in the sea and fresh water, in damp soil, and in other animals, including man. Protozoans cause some diseases, including malaria, sleeping sickness, and a form of dysentery.

There are four kinds of protozoans. *Flagellates* move through water by using long whip-like projections. *Sarcodines* include amoebae, which move by extending pseudopods (see Amoeba), and radiolarians and foraminiferans, which float about in the water and have shells of silica or chalk. *Sporozoans* are parasites and depend completely on their hosts. The malaria-causing parasite belongs to this group. *Ciliates* have small hairs called *cilia* that they wave about to move.

Protozoans reproduce by *cell division*, in which one cell splits into two new ones; by *budding*, in which part of the cell breaks away to form a new cell; and by dividing into smaller cells called *spores*, which may pair up before growing into new animals. The nucleus of the parent cell is always divided among the new protozoans.

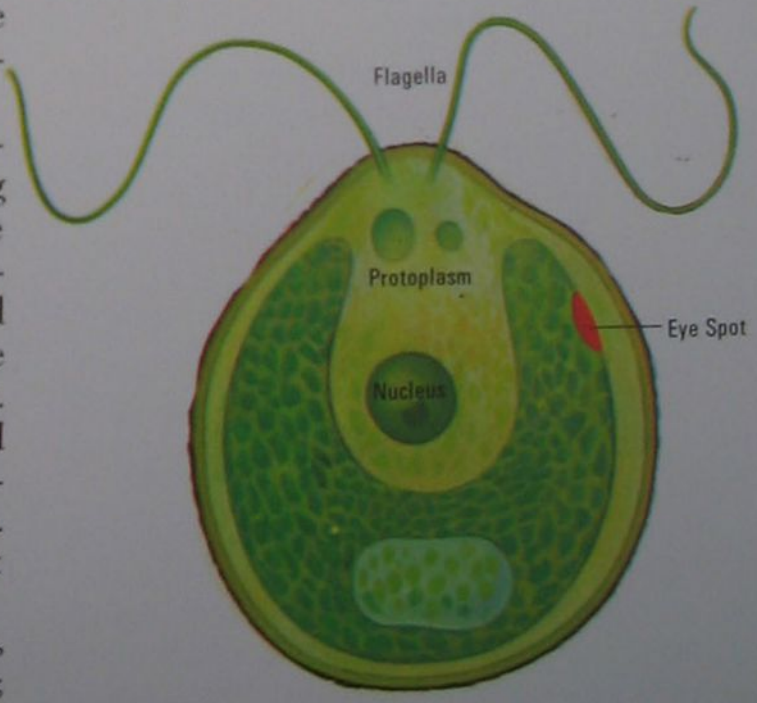
Psychology means the study of man's behaviour and mind generally. The term comes from the Greek word for *soul*. Psychology usually means the inquiry into the workings of a normal mind. As such, it has been carried out in many ways for as long as man has been capable of thinking about the reasons for, and the nature of, his thoughts and actions.

In later years, inquiry into disturbed minds, with definite problems, has been called *psychiatry*, and is virtually a branch of medical science.

In the late 1800's, Sigmund Freud and others began to investigate the mental condition of persons with emotional problems, and the study of psychological states known as *psychoanalysis* resulted (see Freud, Sigmund).

Today, there are many fields of study relating to the mind. The tendency is to incorporate all of them into the

Chlamydomonas is a creature on the borderline between the plant and animal kingdoms.



study and treatment of the mind and emotions. Great emphasis is laid on experiments, in which the emotional and mental reactions of men and women may be tested and measured.

Public Health Many illnesses can be caused by eating bad food, or drinking polluted water, or coming into contact with someone who has an infectious disease. To eliminate such causes of disease is beyond the means of individual people. It requires the overall control that can be exercised only by a government department. This is what Public Health is about.

Many ancient and medieval societies did little about public health, partly through ignorance, partly through carelessness. Human and animal sewage was left about in towns until about a hundred years ago. When towns began to grow rapidly during the Industrial Revolution and a large number of people lived in close contact with each other, diseases like cholera and typhus increased alarmingly. Town governments tried to help by putting in piped water supplies and drains and organizing refuse collection.

A more scientific approach to the problem came when doctors were chosen as local Medical Officers of Health. They were given powers to close unhealthy buildings and to put people with infectious diseases into isolation hospitals so that they would not infect others. Inspectors were appointed to see that such places as food shops and restaurants were clean and hygienic.

Today in many countries Public Health services are highly developed, but a great deal still remains to be done. (See Pollution.)

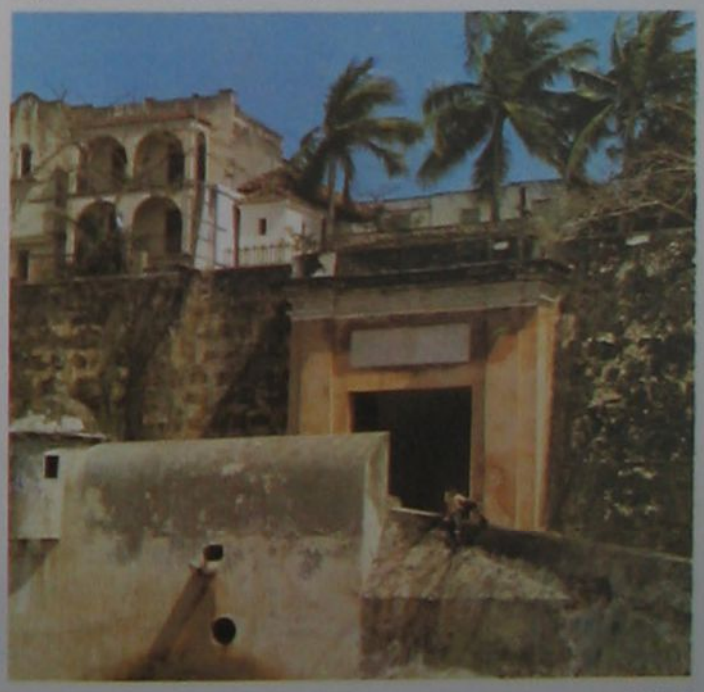
Puerto Rico is an island in the West Indies, a possession of the United States. Its 2,712,000 people hold American citizenship. But they have their own separate government. San Juan is the capital and largest city.

A location map of Puerto Rico.

Puerto Rico has an area of 3,435 square miles. Its beautiful beaches, lush tropical rain forests and warm sunny climate attract large numbers of tourists. Farming is the main occupation of the people. They grow sugar-cane, coffee, pineapples, tobacco and coconuts. Sugar-cane, the main crop, is turned into refined sugar, treacle and rum. Other industries include the manufacture of chemicals, textiles and clothing, and glass and clay items.

Christopher Columbus is believed to have landed on Puerto Rico in 1493. The Spanish began to settle there in 1508. In 1898 the United States gained the island as a result of the Spanish-American War. Spanish is still the main language of the people.

For centuries Puerto Rico was under Spanish rule. Its older buildings, strongly influenced by the Spanish style, are among the many reminders of this.

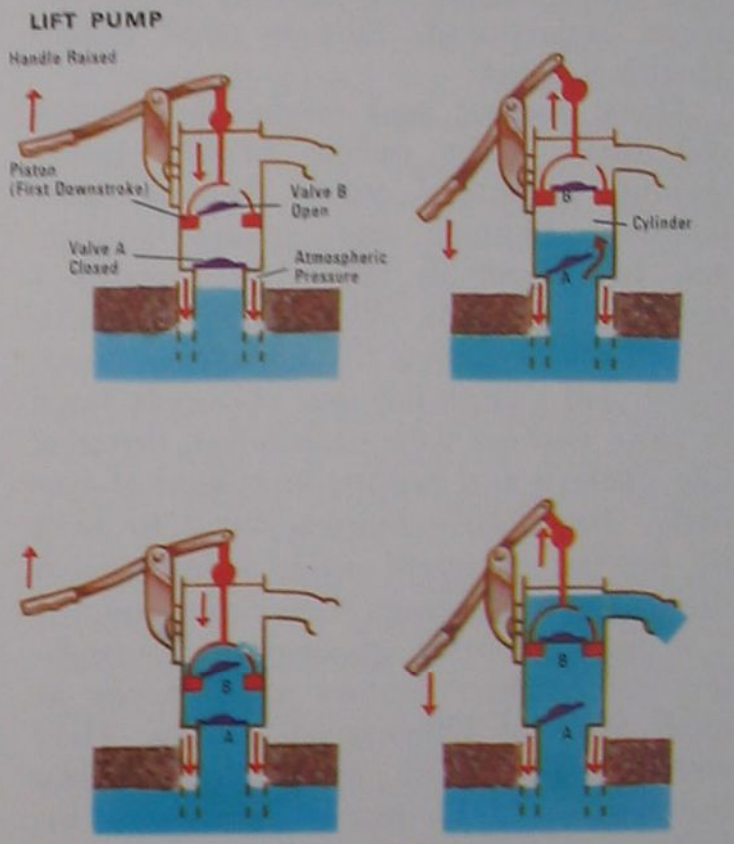


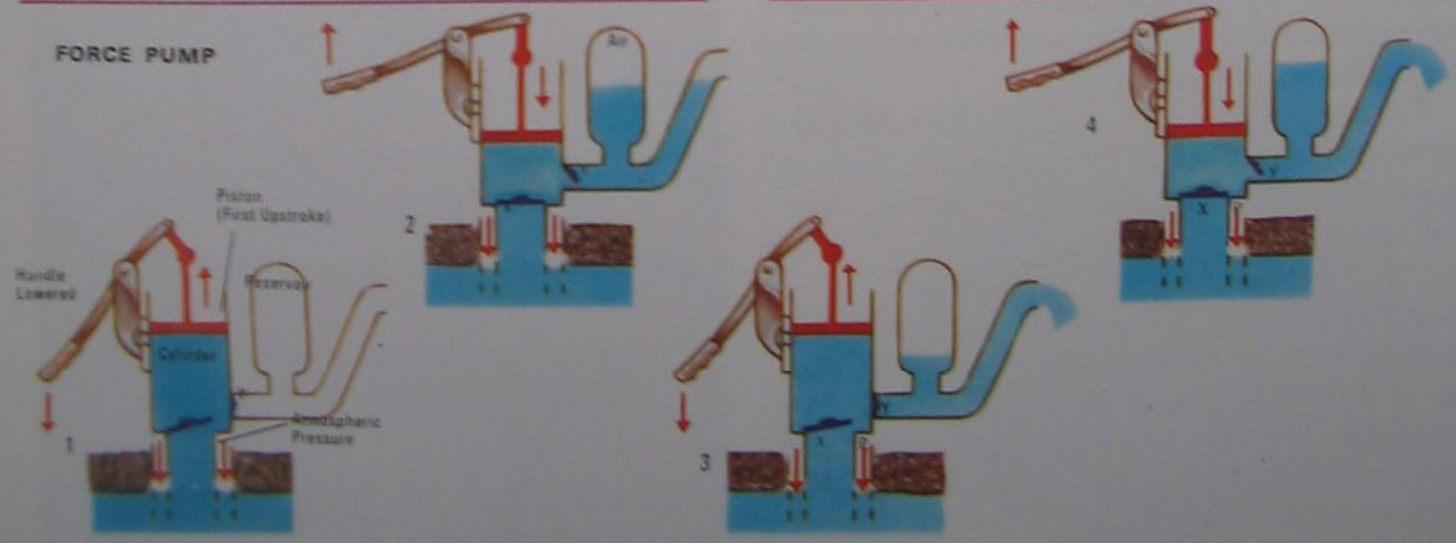
Pumps are generally used for moving fluids. In former times people used them for getting water out of wells. Today there are powerful pumps at waterworks and oil refineries, pumps that work fire engines and fountains, and petrol pumps at garages. Every modern car with a radiator has a pump to force cooling water round the engine, and another pump to force fuel to the engine from the petrol tank. Other pumps move gases, although these are generally called fans or compressors. A vacuum cleaner and a bicycle pump have these kinds of gas pumps. Still other pumps move powders; grain, flour and even powdered coal may be pumped along pipelines instead of being carried in bags.

There are two main types of pumps for lifting water from a stream, a well or a flooded mine. The lift pump has been used for hundreds of years. It has an upright barrel with a close-fitting piston worked by a levered handle. There are two valves: one in the piston and one at the bottom of

Right: Lift pump. 1. First down stroke of piston: increased pressure in the cylinder forces open valve B and closes valve A. As the piston moves down, air escapes from the cylinder through B and out via the hole in the piston. 2. First upstroke: pressure in the cylinder falls. The higher pressure acting on B from the outside closes it. Valve A opens as atmospheric pressure pushing on the water surface forces the water past it. 3. Second downstroke: increased pressure in the cylinder forces open B and closes A. As the piston moves down, water leaves the cylinder through B and out via the hole in the piston to collect above it. 4. Second upstroke: pressure in the cylinder falls. The higher pressure acting on B from the outside closes it. A opens as the atmospheric pressure pushing the water down below forces water into the cylinder. The water above the piston is lifted so that it pours out of the spout.

Below: Force pump. 1. First upstroke of piston: pressure inside the cylinder decreases. Atmospheric pressure, acting on the underground water surface, pushes water past valve X. The higher outside pressure on valve Y closes it. 2. First downstroke: The water space in the cylinder becomes smaller, increasing the water pressure. This closes X and opens Y. The water is forced out into the pipe and some air is trapped in the reservoir. This becomes compressed. 3. Second upstroke. More water is lifted by atmospheric pressure (P) into the enlarged cylinder space. Y is closed. Expansion of air causes a stream of water from the spout. 4. Second downstroke: The cylinder space becomes smaller and the increased pressure in it closes X and opens Y. Water is forced from the spout and more air is compressed in the reservoir.





the barrel. When the piston rises, it leaves a partial vacuum below it. Ordinary atmospheric pressure acting on the surface of the water in the well forces it up the pipe where it passes through the lower valve into the pump. When the piston falls, water passes through its valve into the space above the piston. Finally when the piston rises again, it lifts the water which flows out of the spout. At the same time, more water is lifted out of the well into the pump. Because it works using atmospheric pressure, a lift pump cannot raise water more than about 30 feet in a single go.

To pump water upwards more than 30 feet, a force pump must be used. This resembles the lift pump except that the outlet valve is in a separate side chamber instead of in the piston. Water leaves the pump under the pressure of the downwards moving piston.

Pupa This is the third stage in the life cycle of insects that *metamorphose* (change form) during their lives. The first stage is the egg, and from the egg hatches the second stage, the *larva*. The larva then becomes a pupa, which usually has a hard shell and is often encased in a cocoon. Inside this shell, the larva changes into an *adult*. It does not eat and hardly moves. The shell then splits and the adult, the fourth and final stage, emerges. A pupa, especially of a butterfly, is also called a *chrysalis*.

The larva of the silkworm moth (left) is fully grown, and has just spun a cocoon. Inside the cocoon it turns into a pupa, eventually to emerge as an adult moth (bottom right).

Pygmies The word *pygmies* can be used to describe any tiny persons in general, but *anthropologists* (scientists who study Man) reserve it to describe only Negritos and Negrillos. *Negritos* are Asian pygmies that live in Malaysia and the lands of the Central Pacific Ocean. They are brown-black, and seldom reach five feet in height.

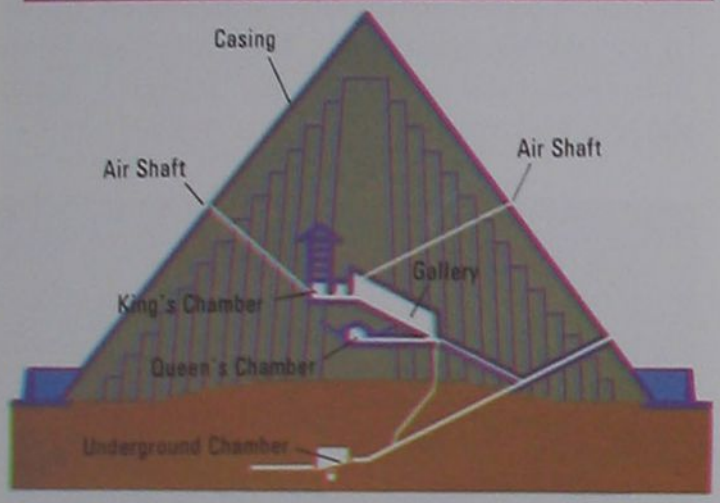
Negrillos live in Cameroon, the Congo Basin, Gabon, Rwanda, and Burundi, in Africa. There are about 150,000 of them in the whole continent. They are less than five feet tall, and live by hunting with their small poison-tipped arrows.

Dr Schebesta and his wife with a group of pygmies in the Congo.

Pyramids are the tombs of the pharaohs or ancient kings of Egypt, and were built between 2600 and 1700 B.C. They are made of stone or brick with square bases and sloping sides, which meet at the apex. Their form probably has some symbolic meaning connected with the idea that the pharaoh was also a sun-god, but the precise meaning is not certain.

The pyramid form has also been found in Mexico, where the Sun and Moon pyramids are very similar to those found in Egypt. This lends support to the idea that the form was connected with Sun worship.

The first pyramid was built in the 3rd Egyptian dynasty by Zoser. His pyramid stands at Saqqara, and was built in the form of a series of steps, 200 feet high. The most famous pyramids are at Giza. They were built by later kings, and the Great Pyramid of King Cheops is made of huge blocks weighing some 2½ tons each. The building is skilful and remarkably accurate. The four corners correspond almost exactly to the four points of the compass, and despite the fact that it was built over very rocky and uneven ground, its north-west corner is only half an inch lower than the south-east corner.



Above: Diagram showing the inside of the Great Pyramid of Cheops.

Below: The Pyramid of Chefron. At the top can be seen the remains of the limestone which originally encased the pyramids.

The huge blocks of stone which make up the pyramids are so carefully fitted together that in most places it is impossible to slide the blade of a knife between them.

The actual method of construction is not known for certain, but it probably proceeded from the centre outwards, and then massive stones on ramps, or drawn by some form of sledge, were hauled into position.

Inside the pyramids were most elaborate burial chambers in which the pharaohs and other royal personages were laid after being embalmed. They were buried with priceless golden treasures and jewels, and all the articles they were likely to need in the next world. Great precautions were taken to prevent the tombs being robbed, but all of them were pillaged. Archaeologists have recovered priceless works of art and actual mummified bodies from the tombs.

Pyrenees is a mountain range on the border between France and Spain. It is 270 miles long, and extends the whole way across the top of the Iberian Peninsula from the Bay of Biscay to the Mediterranean Sea. There are only a few passes through the Pyrenees, and these are difficult to cross. The range is highest in the centre, where two snow-capped peaks rise to over 11,000 feet. The tiny country of Andorra lies within the Pyrenees.

Hydro-electric power comes from fast-running streams in the mountains, and forests of oak and evergreen trees provide timber. Dairy cattle, sheep and goats graze in the valleys and on hill pastures. On the French side, farmers grow olives, wine grapes, grain and fruit. On this side, too, there are several resorts and spas. The Roman Catholic shrine of Lourdes is visited by thousands of pilgrims each year. Many Basques, an ancient people who have their own language, live in the western Pyrenees.

Opposite: A road snakes its way up a Pyrennean mountainside. These mountains form a natural barrier between France and Spain.

Q

Quakers are members of a religious group called the Society of Friends. Quakers are Christians, but their forms of worship are simpler than those of most other Christian groups. Their place of worship is called a *meeting house*. It is a bare room with plain benches and no decorations. There is no priest or minister to lead a Quaker meeting and there is no set service of any kind. Instead, the congregation meditates (thinks and prays) silently. Anyone who wishes to speak during the meeting may do so.

Quakers are noted for their strong convictions about right and wrong. They believe that conscience must guide them at all times. They will disobey laws they consider unjust even if it means going to jail. Quakers are pacifists. They will not fight in wars. They are active in working for world peace. During times of war, some Quakers join ambulance or medical units and set up relief agencies to help the wounded and suffering. Quakers have worked to abolish slavery and to improve conditions in prisons and mental hospitals.

The Society of Friends was founded in England in the 1640's by George Fox. In the beginning, Fox and his followers were ridiculed and persecuted. The name *Quakers* was originally given to them as a form of ridicule. Many Quakers left England for America in the hopes of finding religious freedom. William Penn founded the colony of Pennsylvania as a refuge for them.

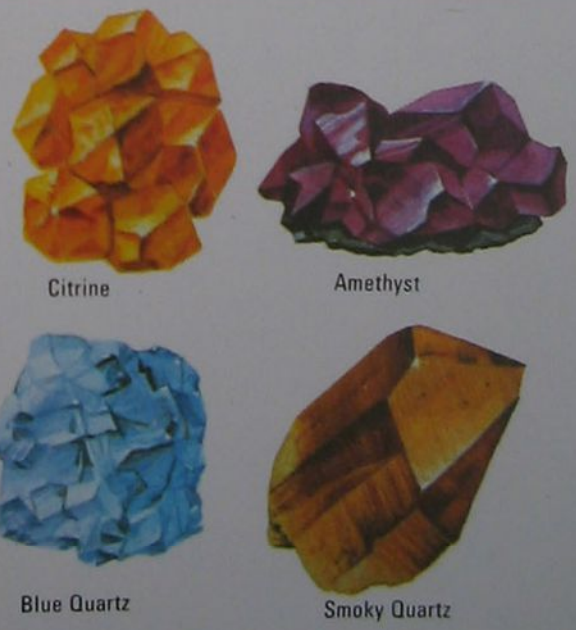
Quarrying is the process of taking rock from open pits in the ground. By *rock*, we mean not only solid, or *massive* rock such as granite, limestone, marble and slate. We also mean loosely packed deposits such as clay, sand, and gravel.

Massive rock used for building stone must be quarried carefully. If it is broken into tiny pieces, it will be worthless. Hard granite is usually quarried by careful blasting with explosives. Softer rock that shatters easily, such as marble, must be quarried by *channelling*—cutting with a saw and prying loose with wedges. Rock used in industry, such as chalk and limestone, is quarried in huge batches by blasting.

Sand and gravel are usually quarried simply by digging with excavators, or dredgers if the deposits lie underwater.

Quartz is the hardest of common minerals. Only rare minerals, such as diamonds, are harder than quartz. Quartz has many uses. It is used to make mortar and glass. Lenses are made from rock quartz. The French scientist Pierre Curie discovered in the 1880's that slices of quartz crystals become electrically charged when squeezed. When it is placed in an alternating electric field, it vibrates at a constant frequency. This is known as *piezoelectricity*.

Pure quartz consists of only two ele-



Some of the many beautiful kinds of quartz. The impurities they contain give them their colour.

A location map of Quebec province.

ments – silicon and oxygen. It is clear and glass-like. Other kinds of quartz are coloured. They include *amethyst* (mauve), *milky quartz* (white), *rose quartz*, and *smoky quartz* (yellow to brown). Quartz crystals are *hexagonal* (six-sided). Grains of quartz are found in sandstone, and the mineral is present in many other rocks.

Quebec, the largest of the Canadian provinces, covers an area of 594,860 square miles. It extends from a frozen wilderness in the north to busy industrial centres and farms in the south. The province has many rivers and scores of lakes. The St. Lawrence River flows through southern Quebec. It empties into the Gulf of St. Lawrence, an inlet of the Atlantic Ocean. The St. Lawrence Seaway, which connects the river with the Great Lakes, is one of North America's chief waterways.

About four-fifths of Quebec's 6,005,000 people are descendants of original French settlers. They speak French in their daily business and observe many traditional customs. French is used in most schools. Most of the people are Roman Catholics.

Quebec's chief cities all lie on the St. Lawrence. Quebec city is the provincial capital. Montreal, where both French and English are spoken is Canada's largest city, and busiest port and manufacturing centre.

Quebec is rich in natural resources. Forests of evergreen trees cover much of the province. Minerals such as asbestos, gold, copper, zinc and iron are found mainly in the Canadian Shield region – the centre and north of the province.

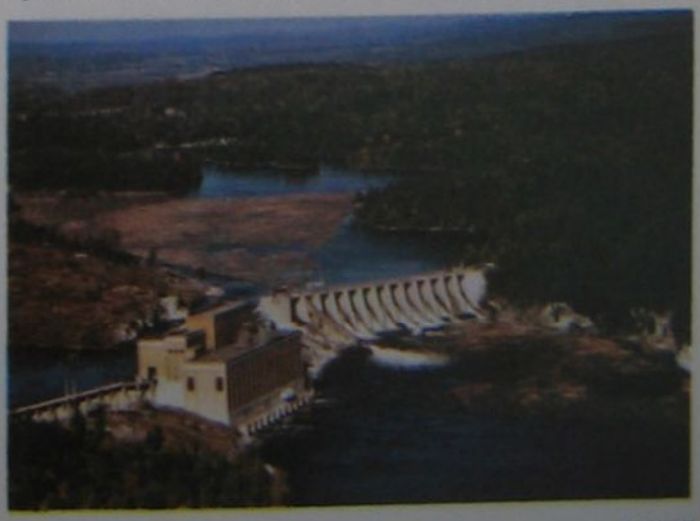
Manufacturing is the leading activity. Products include processed food, and pulp and paper. Metal processing and petroleum refining are important. The province's farms supply milk and other dairy products, apples, potatoes and maple syrup. Mink are raised on fur farms.

The French explorer Samuel de Champlain founded a settlement at Quebec City in 1608. It was the first permanent settlement in Canada. The British captured the city in 1759. Four years later France ceded the territory of Quebec to Britain. Quebec was one of the four original colonies which formed the Dominion of Canada in 1867.

Quebec (pop. 194,000) is the capital city of the province of Quebec, Canada. It is an important seaport on the north bank of the St Lawrence River, 160 miles downstream from Montreal. The city was founded in 1608 by Champlain, on an Indian settlement. The name is believed to come from the Indian word 'Kebec' meaning 'the river narrows here'.

The city is unique in North America as the only fortified town, parts of the upper town still being encircled by walls. The Citadel is the Governor-General's summer residence.

Quebec's growing industries are mainly powered by relatively cheap electricity from a large number of hydro-electric stations on nearby rivers.



Above: A location map of Queensland. Left: Workers in a Queensland coconut plantation. This state lies across the Tropic of Capricorn and has an almost equatorial climate in the north.

Queensland, the second largest state of Australia, covers the whole of the north-eastern part of the continent. Nearly six times as large as the British Isles, it extends for 1,300 miles from north to south, and has an area of 667,000 square miles. Its capital and major port is Brisbane, and its population is 1,820,000.

Queensland borders the Torres Strait on the north, the Pacific Ocean on the east, New South Wales on the south and the Northern Territory on the west. Just inland from the east coast, and running parallel with it for more than 1,000 miles, is the Great Dividing Range of mountains. The narrow coastal strip between the mountains and the sea receives the heaviest rainfall, particularly in the south. To the south and south-west of Brisbane lies the fertile region of the Darling Downs. Westwards the land forms a vast, raised plain, mostly level. Rainfall decreases progressively towards the west, and the rain forests of the mountain slopes eventually give way to grassland and scrubland.

Off the coast there are a number of islands and farther out to sea lies the Great Barrier Reef, the largest coral reef in the world.

The main rivers flowing eastwards into the Pacific are the Burdekin, Mitchell and Brisbane. Rivers flowing northwards into the Gulf of Carpentaria, such as the Flinders and Gilbert, are sluggish and meandering. The rivers in the west form part of the Darling and Lake Eyre systems. Beneath western and northern Queensland lies a great pool of water trapped between rocks, known as the Great Artesian Basin. This water is released to the surface through bore holes and serves to sustain the enormous herds of cattle reared in those regions.

About 20 per cent of the people are farmers, or work in allied industries. Sugar cane is easily the most important

In 1799 and 1802 Matthew Flinders, the British explorer, made detailed charts of the coast of Queensland. Many of them are still used today.

crop. Wheat, barley, fruit, cotton and tobacco are also grown. About half of Australia's beef cattle are reared in Queensland, most of them on the high, dry, western plains. Sheep graze mainly in the central and northern areas and dairy cattle are concentrated on the lusher pastures of the south-east. Mining is very important. In the past, gold and silver brought prosperity to the state. Today, the emphasis is more on the enormous quantities of bauxite available, together with copper, lead and zinc.

About 70 per cent of Australia's overseas trade passes through Brisbane. Other major towns are Townsville, Toowoomba, Ipswich and Rockhampton.

Matthew Flinders first charted the Queensland coast, in 1799. Until 1859 Queensland formed part of New South Wales; then it became a British colony. It joined the Commonwealth of Australia in 1901.

Quicksand is sometimes found at the mouths of rivers or along seacoasts. There the sand is wet and is not supported from underneath. A person who steps into quicksand will sink into it. If he struggles, he will sink even quicker. His best hope of safety is to relax and try to float on his back until help arrives. Episodes of people being lost in quicksand are common in adventure books and films. In real life, few people die this way though animals may wander on to quicksands and be trapped.

Quinine is a drug used to reduce fever and pain in malaria and some other illnesses. It does not cure malaria, but it lessens the unpleasant symptoms and also fights the parasites in the body that cause the disease. Quinine comes from the bark of the cinchona tree, which grew originally in South America. Because of the demand for quinine, some countries in Asia planted cinchona trees, and most quinine now comes from the island of Java, in Indonesia. Several other drugs have now been developed to treat malaria.

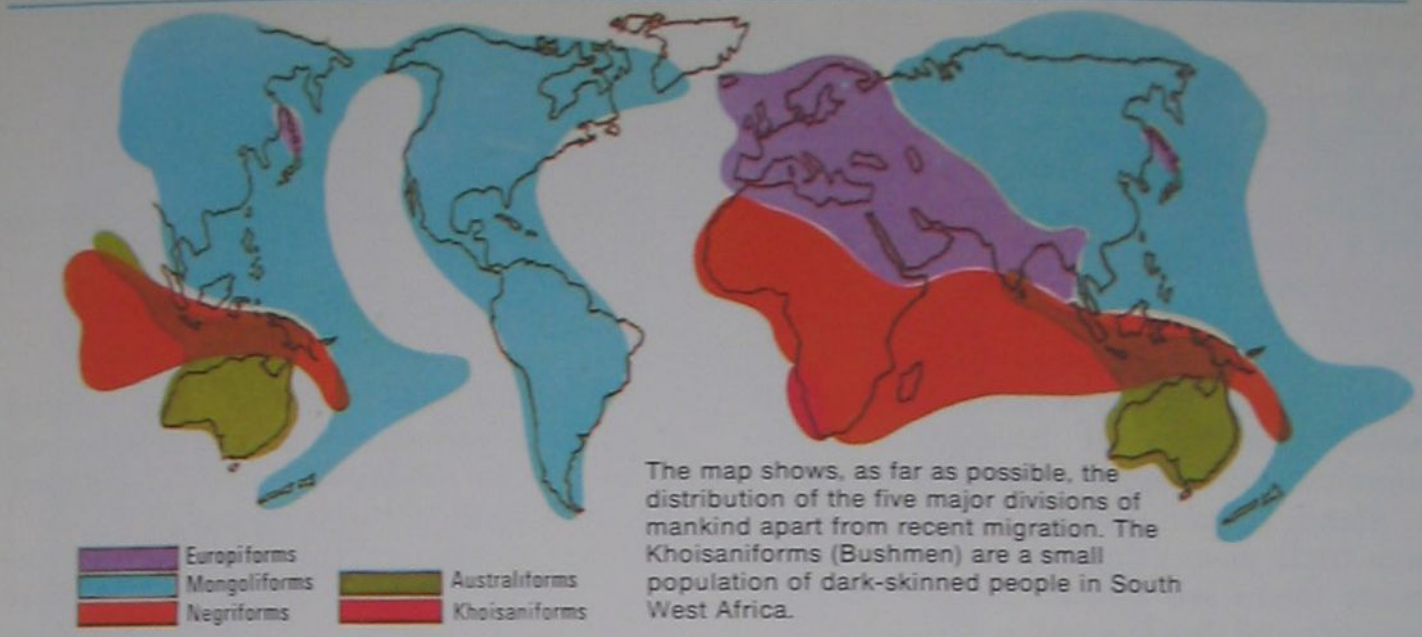
R

Rabbits and Hares are closely related small furry animals. Both animals belong to the order of *lagomorpha*. They have big front teeth for nibbling grass.

Hares are larger than rabbits and grow to about two feet in length. They have powerful hind legs and are fast runners. They live in open country all over the world and are normally solitary. In the mating season, male hares leap about and fight one another with their front legs. This strange behaviour gives rise to the expression 'mad as a March hare'. Young hares are called *leverets*. They are born

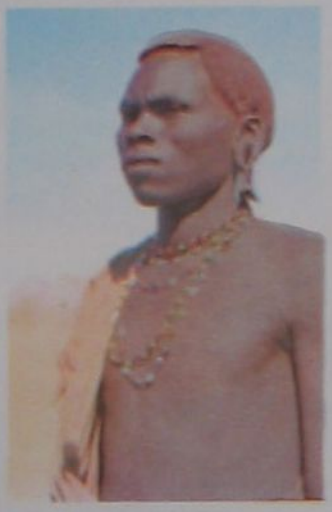
The hare is a herbivorous or grass-eating animal like a rabbit but usually much larger. It is a very fast runner.

Although the rabbit is often a lovable pet, in the wild it causes great damage to crops and pastures.



The map shows, as far as possible, the distribution of the five major divisions of mankind apart from recent migration. The Khoisaniforms (Bushmen) are a small population of dark-skinned people in South West Africa.

Australiforms: Characteristics are a low forehead, plentiful hair on the body, dark brown skin and wavy hair.



Negriforms: Typical characteristics are black skin, woolly hair, thick lips and broad, flat noses.

Europiforms: Skin and hair colour varies from dark to light. The hair is wavy and the nose is narrow

Mongoliforms: The hair is straight and black, the face is flat and the skin is a 'yellow' or 'red' colour.

with their eyes open and with well-developed coats. Hares live in hollows in the ground, known as *forms*.

Rabbits grow to about 18 inches in length. They are found throughout the world in either woodland or open land. They are *social animals* and live in large groups in burrows that they dig underground.

Rabbits do a great deal of damage to farm crops and pastures and farmers consider them a nuisance. Europeans introduced wild rabbits into Australia in the 1800's. From an original shipment of 12 imported in 1859 for sporting purposes, an enormous rabbit population developed. They bred so fast that they became a serious threat to the grazing land of sheep and cattle.

Since the 1950's a terrible disease called *myxomatosis* has destroyed millions of rabbits, both in Australia and in Great Britain.

Races of mankind Human beings living on our planet all belong to the same species. But varying geographical conditions and climates have resulted in the *evolution* (development by change) of different groups called races.

It is believed that all people originally came from one common ancestral type, but the various groups now have distinct

and characteristic differences. However, we should not think of racial differences as being hard and fast, because the races often overlap, and there is no such thing as a pure race.

Nevertheless, some humans are tall, faired-skinned, and blue-eyed, often with light-coloured wavy hair; and others are very dark-skinned, or black, and have short woolly hair, and deep black eyes. Some, again, are small and slimly built, with long straight black hair, and slanting almond-shaped eyes. Such variations are not in fact any more extreme and remarkable than those found between the draught-horse, the slim speedy race-horse, or even the small Shetland pony, which are all descended from the prehistoric horse.

These broad physical types of the human family hand down their characteristics to their children. But, because men move, either singly or in groups, from one part of the globe to another, and intermarry, most countries have a mixture of types.

In addition to differences in colours of the skin, eyes, and hair, there can be characteristic differences in the shape of the head and nose, and in the bulk and average height of people.

In Europe, most nations are a mixture of several races. The Nordic types are found mainly in the north and west, and as a rule these peoples have long narrow heads, fair colouring, and blue eyes, and are quite tall. The Alpine type is darker than the Nordic, having a rounder head, and is shorter on the whole, and often has brown eyes. This type is found chiefly in central Europe and in a broad belt of land stretching from western France as far as Persia in the east. Around the Mediterranean, people are dark-haired, but inclined to be short, and slightly built.

Mongoloid races are found all across the continent of Asia, and have spread east, through migrations, to become the Eskimos and American Indians; south-east into the Pacific Islands; and west to become the Lapps of Europe. Their heads are round, covered in long straight hair, and their skins are yellow or brown. As a rule, they have short flat noses and slanting eyes.

In Africa south of the Sahara the people are of the Negroid type (short woolly hair, black skin and eyes). Farther south still, the Congo pygmies, Bushmen and Hottentots of southern Africa differ greatly and are thought to be of different races.

Both North and South America are believed to have been peopled originally by very early migrations from eastern Asia, where the Mongolian race is dominant. The many tribes of American Indians are descended from these early migrants. The majority of white Americans are descendants of the European types who settled there.

The Australian aborigine is of the Australoid type, with dark skin, wavy hair, and overhanging eyebrows. Similar types are found in some Indian jungle tribes. New Zealand Maoris are Polynesians, mainly Mongoloid, but taller than average. This type is found all over the Pacific. Papuans and Melanesians, who live from New Guinea to Fiji, are Negroid types, though their noses are long and they have long mop-like hair.

Racoons are fox-like mammals. One type of racoon lives in almost all parts of North America, including built-up areas.

The racoon hunts by night and is reputed to wash its food in water before eating it.

It has a fox-like head, long, greyish-brown fur, and a bushy tail that has dark ring markings. It grows to a total length of about 2½ feet. It is a good climber, and often lives in hollow trees. It feeds on almost anything from small animals and plant food to garbage.

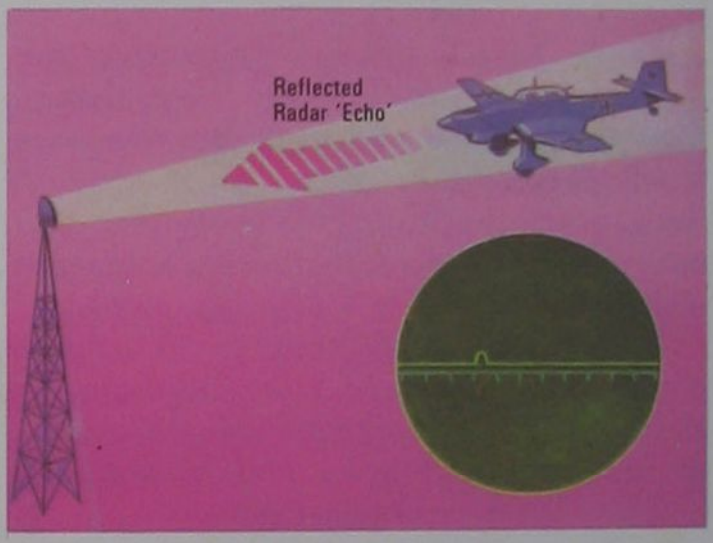
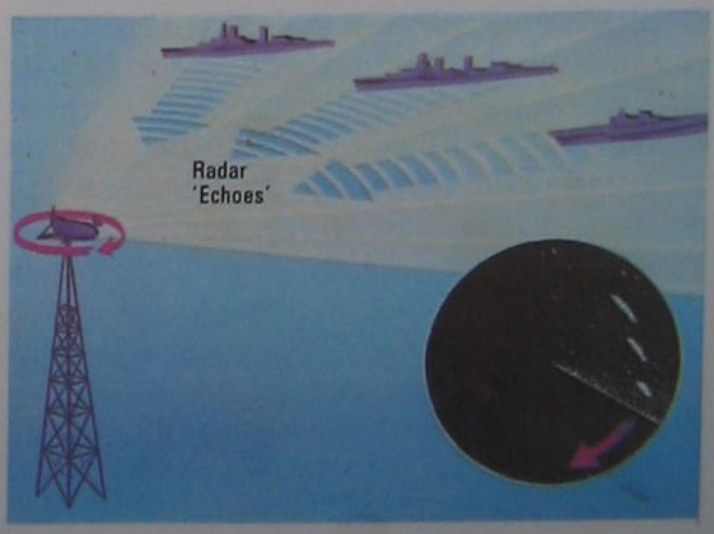
The crab-eating racoon of South America has longer legs, a much less bushy tail, and short brick-red fur. It lives along river banks and sea-shores and is fond of crabs, shellfish and small fish.

Radar Stands for *R*adio *D*irection *A*nd *R*ange. It was first developed in the late 1930's after scientists had noticed that aircraft reflected the radio signals transmitted from broadcasting stations. Today, in a highly sophisticated form it is used to navigate ships in fog, land aircraft in low visibility, detect and control missiles and catch motorists who are exceeding the speed limit.

Radar works by transmitting a very high power pulse of radio energy for a short period. The radio energy spreads out from the radar set at a speed of about 186,000 miles per second. Any object in its path such as a ship or an aircraft will reflect some of the energy back towards the radar set—like a mirror reflecting light. In the radar set a radio receiver picks up the reflected energy and electronic circuits measure how long it took for the energy to travel to the object and back. If the time taken was one second then the energy must have travelled 186,000 miles and the object must be half as far as this (93,000 miles) away. For an object only 164 yards away the time interval is only one microsecond; but this can be measured very easily with modern electronic circuits.

The direction in which a target lies is determined by arranging to send the radar pulse out in one direction only using a *directional antenna.* The antenna can be rotated automatically or by hand until reflected energy, an echo, is picked up. The object clearly lies in the direction in which the antenna is pointing.

Navigational radar sets on ships normally use a type of display known as a *Plan Position Indicator,* or P.P.I. The radar antenna is rotated continuously at about 20 revolutions per minute. At the same time a radial line on a *cathode ray tube* on the bridge of the ship rotates to 'point' the display. When an echo is received a spot of light appears on the line. The centre of the tube is the ship's position: the distance on the tube between the centre and the echo tells the captain how far the ship producing it is away from him. He can tell the direction of the ship from the direction of the echo from the centre of the tube.



Above: When the radar signal is a narrow beam of waves, the reflected 'echo' is a bump in the line of an oscilloscope trace.
Below: When the beam is spread out over a wider area, the ships show up as bright patches around the oscilloscope screen.